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Unasylva

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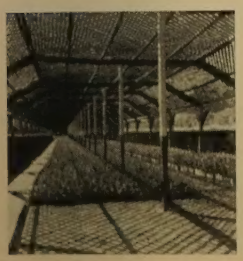
FAO PROGRAM 1957

ONE of the final acts of Dr. P. V. Cardon before his retirement as Director-General of FAO was to prepare a program of work for 1957. In compiling this program he was influenced by the feeling that it was particularly in the field of forward planning and advisory services that member countries were looking more and more to FAO for assistance; the Organization's regular program over the past ten years had created the resources from which this policy advice could be provided, while its Technical Assistance Program represented the effective utilization of these background resources to particular and individual cases.

The provision to underdeveloped countries of direct advice and assistance and training facilities for personnel has always been recognized as part of FAO's responsibilities, but its effective deployment was not possible until additional resources were available through the establishment of the United Nations Technical Assistance Program. Even now, notwithstanding the generosity of the countries contributing to this program, the resources available are far from sufficient to meet the needs of the underdeveloped countries or the cost of the services which FAO is anxious to furnish.

Nevertheless, these additional resources have enabled FAO more efficaciously to develop these direct services to member countries and have modified in some degree the structure and character of the Organization and the orientation of its efforts. Instead of being a body concerning itself largely with broad technical and economic questions, developed through the media of meetings, consultations and publications, its main preoccupation now is providing direct help.

FAO's strength in providing such direct assistance to member countries lies in the fact that it is itself a co-operative body. Its members comprise almost all the nations of the world — those providing technical and financial help and those receiving it. By virtue of its international character, FAO can draw upon the greater part of the world to obtain the most disinterested and skilled advice available.



Cover photograph: *Individually potted eucalyptus seedlings being grown under shade in a nursery in Chile.*

Photograph by Victor Bianchi. By courtesy of the Departamento de Bosques, Ministerio de Terras y Colonización, Chile.

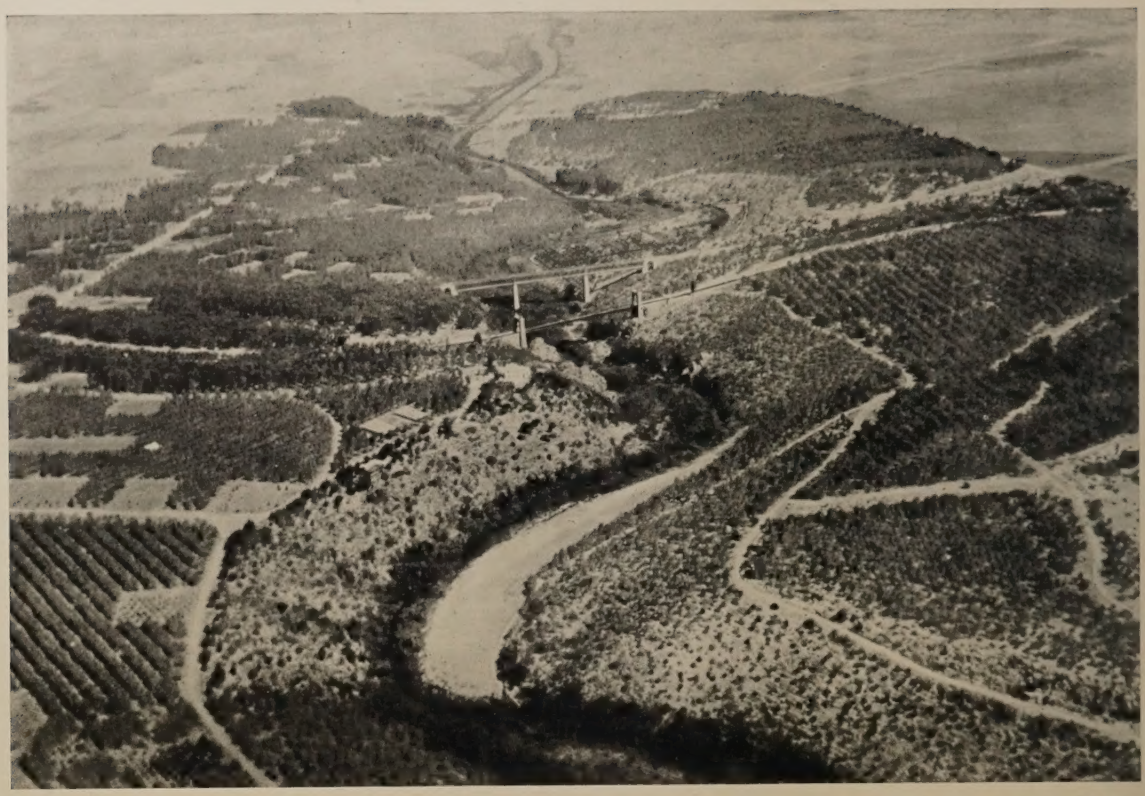


FIGURE 1. *The arboretum of Wadi Cherrate, created in 1947 within a reforestation area where planting was begun in 1933, consists of a collection of 127 species of eucalypts which seemed to be the most interesting for reforestation in Morocco. This arboretum is supplemented by a number of field trial plantings throughout the country.*

Photograph by Forest Service, Morocco

FIGURE 2. *Natural regeneration of* E. camaldulensis *in Australia on a burnt-over area: in the background can be seen the new young growth.*

Photograph by A. de Philippis

Eucalypt Woodland in Australia

Background Factors Influencing Occurrence and Treatment

by M.R. Jacobs
Principal and Lecturer in Silviculture, Australian Forestry School, Forestry and Timber Bureau, Australia

Before European colonization took place, a considerable proportion of the continent of Australia was covered by savanna woodland or high forest in which eucalypts were the dominant trees.[1]

The size of the trees varied with rainfall and temperature but was usually remarkably good for the conditions under which they grew. In areas receiving an annual rainfall of less than 15 inches (37 cm.) the trees might be between 6 and 30 feet (1.8 to 9 m.) in height. Most of the better savanna woodland received from 15 to 30 inches (37 to 74 cm.) of rain per year in the cool temperate zone, or from 30 to 60 inches (74 to 148 cm.) in the tropics and was characterized by veterans with a height of 60-100 feet (18 to 30 m.). In the wet schlerophyll high forest, the height of the dominant veterans was about 150 feet (45 m.) over a wide range of latitude, the annual rainfall varying from 40 inches (100 cm.) or more in cool temperate parts to 70 inches (177 cm.) or more in the tropics. The best forest sites of southern Australia, receiving an annual rainfall of 50 inches (127 cm.) or more, carried eucalypts which attained heights of 150 to 250 feet (45 to 76 m.) over areas of hundreds of thousands of acres, and heights of 250 to 300 feet (76 to 90 m.) in limited localities.

While the interaction of rainfall and temperature was the main factor which controlled the size of the trees, other influences played their part. Naturally better forests developed on the good soils than on the poor soils. Exposure to storm winds was also significant. The very tall eucalypts were situated in areas where severe cyclonic winds were uncommon.

Natural Succession

Effect of fire and grazing before European colonization

Grazing and fire have been very significant factors in the eucalypt woodland but their effect has varied with the nature of the forest type.

The native grazing animals of Australia were marsupials, which do not crop the grass closely as does the sheep or the rabbit. This was a favorable factor in the eucalypt forest. Nearly all the savanna woodland species develop lignotubers, and these structures were able to establish themselves in one good season and make trees in later favorable times. The native Australian grasses tended to form clumps with a little bare ground between them rather than swards, and this also assisted eucalypt regeneration. It should be stated, however, that in the absence of grazing and fire the eucalypts will regenerate through dense grass swards in a few years if there is a good seed supply.

It is likely that the eucalypt woodland experienced periodic fires even before human occupation. The widespread presence of understorey species bearing seeds adapted to germination following fire suggests a long fire history.

The known human occupants of Australia have all burned the woodland. The aborigines were stone age hunters. They congregated where game was most abundant and the savanna woodland was one of these localities. The wet schlerophyll forest and the very dry areas were relatively poorly stocked with animals and supported few aborigines.

The aboriginal hunter frequently sought his game with the aid of fire, but it was not in his interests to start large conflagrations. He knew the danger of a large fire, but he did not have effective means of suppressing flames of appreciable size so that it was inevitable that his fires should get out of control at frequent intervals. The effect of his fires was to keep much of the savanna woodland very open, and to favor the lignotuberous eucalypts against genera which might be more tolerant but less fire resistant.

Most of the high quality eucalypt forest of Australia abutted upon savanna woodland which was regularly burned by the aboriginal hunter. When the hunting fires got away they burned into the good forest to an extent which varied with the weather conditions. Sometimes they moved short distances as ground fires and did little damage, but in the years of very high temperatures and severe winds they developed to major crown fires which sometimes devastated extensive areas. The effect of these fires in the high forest has been to restrict some species and extend others.

Fire is the one factor which permitted the establishment and maintenance of eucalypt forest on many sites of high quality in southern Australia. In these local-

[1] A paper prepared at the request of FAO for the World Eucalyptus Conference being held at Rome, 17-30 October 1956. This conference will consider the eucalypts in world forestry from the standpoint of value, problems basic to planting, establishment, management, and protection, use for soil stabilization and shelterbelts, and all aspects of utilization. This article on the factors influencing the occurrence and treatment of eucalypt woodland in Australia deals with one of the important subjects to be considered at the eucalypt conference. The author has recently published a basic textbook, *Growth Habits of the Eucalypts*.

ities the eucalypts would have been replaced by more tolerant genera if major fires had not recurred at intervals. The intervals may have been as long as 300 years.

The occurrence of some valuable eucalypts has been restricted by fire. Some species have barks which are very sensitive to fire and they are of limited occurrence because of this fact, in spite of good natural vigor.

Fire and grazing after European colonization

So the aboriginal hunter deliberately burned the savanna woodland to obtain food. He did not deliberately burn the high forest to any extent because it did not contain much game.

The earlier European colonists depended on the savanna woodland to support their flocks and herds, so that the hunting fires of the native were a nuisance to them. Grass would be destroyed early in the summer and not be available for the new type of grazing animals introduced by the European. The animals themselves might also be endangered by the fires. Consequently, the aboriginal soon disappeared from the savanna and, in this class of country, the advent of the European decreased the incidence of fire in many places. Unfortunately, the reverse was the case in the better forests. While the native hunter could get little benefit from firing the high forest, the European could obtain profitable grazing for his cattle on the succulent shoots which developed when trees and shrubs were destroyed and the forest was opened up. The European greatly increased the amount of burning in the better forest, with unfortunate results for the mature trees. The damage caused was partly offset by the fact that the opening up of the canopy by fire permitted the establishment of advance growth on the forest floor. This advance growth gives the Australian forester of today a chance to re-establish a healthy and vigorous forest with the aid of protection and a little treatment.

Succession in the absence of fire and grazing

Nearly all eucalypt forests in Australia owed their nature to fire and grazing at the time the forester took charge of them. The first result of protection from fire and grazing in all of them is a much denser and darker forest in the course of two or three decades. Eucalypt advance growth develops rapidly and understorey species multiply. If protection without utilization were carried on for a long period the result would vary with the nature of the forest. The tall eucalypts, 150 to 300 feet (45 to 90 m.) in height would be replaced by more tolerant genera. The dry schlerophyll forest, and the better savanna woodland at low altitude, might be invaded to some extent by tolerant genera but could probably maintain themselves as somewhat open forests in which the eucalypts were prominent. High mountain woodland might remain stable as an open park-like eucalypt forest with large trees and grass on the forest floor.

The notes given above will show the pronounced effect of fire and grazing, and the lesser effect of soil and storms, in the natural eucalypt forest. When man regenerates these stands he must replace the effect of fire by his own work. The forester outside Australia who wishes to plant eucalypts should also take note of the effect of fire in Australia. He may be justified in experimenting with species over a wider range of sites than that on which they are found naturally.

Effect of Utilization

The aboriginal made little use of the eucalypt forest. The European destroyed many millions of acres of it to establish farms and pastoral holdings and is now attempting forest management over perhaps 20 million acres (8 million hectares).

Effect of utilization in the savanna woodland

The better savanna woodland has nearly all gone to farm or pasture in southern Australia. Some of the trees were felled and utilized for farm purposes, railway sleepers and so forth, but most were simply ringbarked. The ringbarked trees have supplied firewood of high quality for three generations of Australians and they will be sădly missed when they disappear, as they inevitably must. In some localities, far too many live trees have been removed and there is already a shortage of trees for shelter or for farm purposes. The position is being aggravated by the fact that some of the worst enemies of the eucalypts of the savanna are scarab beetles which feed on grass roots in the larval stage and on eucalypt foliage when mature. The increase in the proportion of grassland to trees with colonization is leading to progressively more severe attacks on the remaining trees by mature beetles. The solution of this problem must be to develop unpalatable strains of eucalypts or plant trees of genera which are not attacked by the insects.

Effect of utilization in the better forest with a mature height of under 150 feet

Most of the eucalypt forest with a mature height of under 150 feet (45 m.) is composed of fire-resistant species. The virgin forests were irregular, with a preponderance of old trees. The old trees would occasionally fall because of the combined effect of wind and fire, and regeneration would come up in the resulting gap, so that a considerable range of ages and sizes developed in the course of time. When this class of forest was first utilized by the European, the best trees were taken for industry. Then the Forest Services introduced minimum exploitable girths at a relatively early date in order to keep some control over utilization. The inevitable result was the development of utilization by selective fellings. Groups of regeneration came up in the gaps made by the selective fellings, and the growth of older trees near the gaps was stimulated. These stimulated trees provide the mill logs for a later felling cycle, and so the stage is set for further selective fellings.

The selective fellings have led to a silvicultural system now well known as the Australian Group Selection System. The typical theoretical example of the past was an irregular forest composed of groups of trees of even age which regenerated in small cleared areas made by successive fellings. The ages should be multiples of a planned felling cycle in any one compartment. The typical example of the future is likely to consist of an irregular forest where some trees are taken for industry from convenient areas planned in advance, and the remaining dominants of all sections of the sequence of size classes are stimulated by their removal. It will be possible to carry on the eucalypt forest mainly with the aid of commercial fellings and without the use of fire. The disturbance of the soil by snigging (dragging) and the opening up of the stand by the fellings will permit adequate eucalypt regeneration to develop. Assistance, apart from commercial fellings in the form of liberating seedlings from competitors and vines, some thinning of saplings and, where necessary, a little enrichment planting, will greatly improve the quality of the future forest.

Utilization and regeneration in the high quality forest over 150 feet in height

There is a mature limit close to 150 feet (45 m.) which represents the height at which it is desirable to change from selective fellings to clear fellings in a eucalypt forest. Stands less than 150 feet in height can be managed indefinitely by selective fellings. If the forest is taller, selective fellings are difficult to execute effectively, though not impossible, and the light relationships of the resulting gaps are not suitable for the satisfactory establishment of eucalypt regeneration. The wall of surrounding trees is too tall for the radius of the gap and tolerant genera are likely to take control. Moreover, many of the very tall eucalypt forests are even-aged stands of one fire-sensitive species which regenerated after some past disaster. It is desirable to carry this type on as even-aged forest. Should it prove practicable to thin the stands for commerce, the yield obtained from them will be increased appreciably.

Likely Future Developments in Australia

Improving the stocking on valley soils

In many parts of the better eucalypt forest of Australia, the best soils are in the valleys and they are poorly stocked with desirable trees. There are two reasons for this. First, past fires were usually more severe on the slopes and ridges, and the fires favored the eucalypts. In the valleys, tolerant weed species were stronger and strangling vines frequently led to the suppression of scattered eucalypts. Secondly, the traditional road of much of the eucalypt forest was a ridge road because it could carry traffic in all weather. Valley roads which permitted better exploitation of the best soils were not popular because their use was restricted to the drier periods. Valley tracks will be used more extensively in the future. With their aid it will be practicable to utilize the better soils effectively, and forest production will be improved.

Organization of felling areas

Some planning of fellings has been practiced in Australia for many years, and at present there is a strong move for better control and better planning of the location of utilization. This will permit the Forest Services to adhere to working plans, to protect the forests from wind and to aid regeneration by a well-conceived pattern of age classes.

Edges of seed trees

It has become apparent that the usual type of seed tree left in clear cuttings is not suitable for its purpose. As in all forests, the best seed-bearing eucalypts are the dominants, but the dominants are wanted for industry. To get over the difficulty, the pattern of fellings will be designed so that an edge of mature forest sheds seed on to a recently felled coupe, rather than leaving scattered seed trees of inferior quality.

Insects and eucalypt regeneration

The surplus seed of most forest types has provided food for a variety of forms of animal life. In the case of the eucalypts, the seed is small and the main seed-eating animals are ants and other small insects. These creatures may steal most of the seed produced by an edge of seed trees and be a significant factor in reducing the amount of regeneration obtained. Recent insecticides such as chlordane and deildrin have proved effective in suppressing seed-robbing insects, on an experimental scale. They can be applied cheaply and may prove useful on a larger scale in certain cases where full regeneration is required in high quality forests.

Broadcast sowing of seed

There is usually an adequate seed supply to regenerate areas not already colonized by advance growth in the eucalypt forests with a mature height under 150 feet (45 m.), if the felling units are not too large. Against this, seed may be in short supply in the older even-aged high quality forests over 150 feet in height. These forests carry a heavy volume, and utilization by clear felling usually leaves an area where the soil has been well churned up, but where there is an interlocked mass of broken smaller logs. The areas are not large but they are difficult to plant by hand. They are almost ideal for broadcasting from a helicopter if means can be found to pellet the eucalypt seed to give it more weight. A small helicopter could be carried close to the area by transporter. A suitable insect repellant might be added to the pelleting material.

Enrichment planting

Two decades ago, a eucalypt tree had little money value in Australia and enrichment planting could not be considered. This is not the case today. The present and likely future value of eucalypt logs makes it essential that full stocking should be obtained in the better forests. Experience has shown that the favorable branch-shedding habit of the genus permits trees of good form to develop from scattered regeneration in the irregular stands, whereas poor form results from corresponding spacings in cleared areas. This favorable form resulting from scattered regeneration in the selection forest makes it possible to complete the stocking of many areas by enrichment planting with relatively few plants. It is also possible to introduce elite trees into a stand by enrichment planting.

Enrichment planting in Australian eucalypt forests is done with individually tubed stock and not from heavier containers holding a number of plants. The reason why tubed stock is necessary is that it is possible to climb over crisscrossed useless logs and slash with a few tubes, but not with a heavier container.

Properties of gaps

The gaps in the eucalypt forest in which regeneration develops are biological units which can be made use of in regeneration problems. The lighting of the gaps depends upon the nature of the surrounding wall of vegetation, the shape of the gap and the relationship between its height and width. By regulating these factors it is sometimes possible to control the nature of regeneration in mixed forests.

Yields from different species and behavior of species

In the mixed eucalypt stands, the individual species have varying degrees of tolerance, varying reactions to fire, varying crown and root habits, and varying growth rates. In the past, it has seemed that the trees with the fastest individual growth rates would produce the most timber. It now seems likely that the future will show, as it has elsewhere, that the best yield per acre per year from the soil, and the best forest in the end, may come from growing the more tolerant species on a longer rotation.

Working towards greater or less irregularity in compartments

In the irregular stands managed by the Group Selection System, it is possible to increase or decrease the range of sizes in compartments by organizing successive fellings so that they create more groups on the one hand or extend older groups on the other. It is not yet clear which is the better method. An increase in irregularity of compartments may produce the better biological unit. Against this, it is practicable to decrease irregularity and obtain compartments completely stocked with trees of pole size or larger. In the case of fire-resistant species, it is practicable to control burn compartments of this nature without great harm to the trees, a fact that may be very useful near forest boundaries.

Application of Australian Experience Overseas

Savanna species will not be of much importance in the Australian timber trade of the future, but they should be of great interest in overseas localities where eucalypts are used to afforest difficult areas. The savanna species have evolved in spite of repeated firing, and they are particularly hardy. Many of them do not make trees of milling quality in close association, but others could make a useful forest. The trees which are likely to make a good forest have some of the normal characteristics of tolerance, such as a higher degree of branching than is usual for the genus. Overseas foresters would do well to study crown characteristics of available specimens in local arboreta before selecting species for extensive work.

Eucalypts from forests of very high quality may be of less interest overseas than the species from the savanna. The eucalypts occupy the high quality forest as a result of fire and more efficient genera can be found for these areas. The crown structure of the eucalypts is ideal for rapid growth of individual trees, but not so well suited for the production of a large volume of high quality sawlogs per unit of area.

Eucalypts grow much faster in suitable localities outside Australia than within Australia, provided the leaf-eating insects which have evolved with the genus in Australia are not introduced also. The faster growth of the trees overseas may be accompanied by poorer wood quality than is obtained in Australia because growth stresses have not had time to adjust themselves. The position can be assisted by increasing the length of the rotations over which the trees are grown.

Overseas foresters should pay as much attention to the strain of a species introduced from Australia as to the species itself. Many of the species are very variable, particularly those which occur over a wide range of latitude. Some strains may make good forest trees and vice versa. Expenditure of appreciable funds on strain selection and collection from élite trees within the strain is likely to prove a very profitable investment.

In most places in Australia, it is impossible to dispose of a considerable proportion of the woody material produced in the eucalypt forests. The better logs are utilized and the remainder are left crisscrossed on the ground, making access within a compartment difficult. The overseas countries most interested in eucalypts are usually short of all woody products. In these countries, eucalypt plantations are established on well-prepared, fully cleared land. Even the smaller logs are likely to be saleable. The different market conditions may lead to strongly contrasted methods of treatment, each of which is right in its locality. Both the Australian and the overseas forester should bear this in mind.

Bamboo Culture in the South Pacific

by F.A. McClure
Section of Plant Introduction, United States Department of Agriculture

The possible impact of the introduction of bamboo culture on the future economy of areas such as the Pacific islands is a matter deserving serious consideration.[1] The importance of bamboo in the economic life of people in large areas of the Eastern Hemisphere and the steady emergence of bamboo into certain phases of modern industrial development such as paper making and the fabrication of laminated bamboo products, not to mention the large potential (and at present very inadequately supplied) market in the United States for bamboo in diverse forms for interior finish, handicrafts, prefabricated picket fences, etc., leads to the assumption that bamboo might be used as an effective means of improving the domestic economy of the Pacific island peoples.

Bamboo occupies such an important place in the human economy of some regions, particularly in southeast Asia and adjacent islands, that the majority of the people would be utterly destitute without it. In vast areas, bamboo is the one material that is sufficiently cheap and plentiful to fill the tremendous need for economical housing. It is at the same time so versatile that from it are made hundreds of objects in daily use in the home and in the pursuit of a livelihood. Moreover, it requires no elaborate and costly machinery for its harvesting, or transportation, or for the manufacture from it of the thousand and one articles that fill the needs of the people. The general utility knife that every man possesses serves for all but the most refined operations.

The exploration of the potentialities of bamboo as an expanding resource for the Pacific island peoples calls for judgment based on past experience in numerous fields or disciplines, and for exploratory activities of several kinds.

The number of localities and their degree of dispersion as well as the total area in which operations may be undertaken will be determined by the funds and personnel time that may be allotted to the enterprise. The actual selection of particular communities and areas will require a careful consideration of ecological and economic settings. These must be evaluated in terms of immediate needs and calculated potentialities. Immediate needs may relate to the land: need of conservation of soil and water, need to improve existing patterns of utilization, etc. Immediate needs may characterize the state of the population: need of new sources of income, new incentives, new perspectives.

Important consideration of limiting factors

Limiting factors must be weighed. Among these will be the nature and extent of the land area available to a given community. Low annual precipitation, inadequately-developed (geologically young) soil, and high salinity are apt to be encountered frequently. Any one of these factors could exclude the possibility of growing bamboo. It is not possible, however, to give the precise boundary at which each alone, or any combination of them may operate to block the successful cultivation of bamboo or make its trial inadvisable. There are indications that certain bamboos will tolerate unrecorded extremes of drought: *Dendrocalamus strictus*, *Bambusa vulgaris* and *B. ventricosa*, for example. The degree of tolerance to salinity that any bamboo may display has not been studied. It is presumed, however, that initial activities will be undertaken where the conditions at least appear to be favorable.

As a first step, a survey to determine the identity, condition, abundance and utility of the bamboos already introduced in the Pacific islands would be of the greatest value. This information would obviate the waste involved in introducing valuable kinds already locally available. A perspective comparable to some years of actual experience could be developed by an on-the-spot study of the history of their introduction and the present state of the plants, as well as the nature, extent and success of their exploitation in the local economy.

The chances for improving land-use patterns, and local opportunities for utilizing bamboo, will vary from area to area.

The cultivation of bamboo is closely related to the needs of the land. Oriental bamboo growers claim that the technical properties and lasting qualities of a given bamboo are generally superior when the plants are grown on soil of somewhat inferior fertility. They counsel against fertilizing a bamboo plant that is grown for its culms alone. From this it is to be inferred that it may be undesirable, as well as economically unsound, to utilize the most fertile agricultural lands for the cultivation of bamboos for timber production.

[1] This article has appeared in the January 1956 issue of the *Quarterly Bulletin* of the South Pacific Commission, an advisory and consultative body set up in 1947 by the six governments responsible for the administration of Island Territories in the South Pacific region (Australia, France, the Netherlands, New Zealand, the United Kingdom and the United States of America). The Commission's purpose is to recommend to the Member Governments means of promoting the well-being of the people of these territories. It is concerned with social, economic and health matters. Its headquarters are at Noumea, New Caledonia.

In the cultivation of tropical bamboos for the production of edible shoots, friability of the soil is of greater importance than fertility. The annual operations of clump renovation and subsequent hilling up of the earth around the base of the clump to etiolate the shoots are performed with greater ease and effectiveness if the soil is not too heavy. The application of prescribed soil amendments at the right times and in the right amounts to get maximum yield and quality is elsewhere considered a sound and economical practice. But it must be tested afresh under each new or distinct combination of ecological, economic and human factors.

Very little has been written about the potentialities of bamboo as a stabilizer of soil and controller of run-off from the angle of soil and water conservation or watershed stabilization. The dense shade cast by the plants keeps competition from weedy growth to a minimum. The abundant annual leaf-falls develops a deep mulch under the plants. This conserves moisture, contributes to the development of favorable conditions for the building of good soil, and promotes normal development of the plant. Furthermore, the culms may be harvested without seriously disturbing the mulch or the soil. I know of no other type of plant growth that can yield an annual crop and at the same time serve as an effective year-round long-term protector of watersheds.

Considering bamboo as it relates to the needs of the people, it will be useful to study the exploitation of bamboos from two distinct angles: that of present and potential uses in the immediate community, and that of export possibilities. Uses important in one cultural or economic setting might be viewed with no more than curiosity by persons from another milieu. Objects that have no use, application or value in the place where they are fabricated may bring a substantial price if exported to another area where either the bamboos are lacking or the essential skills have not been acquired, or labor costs are too high.

Uses for island fishermen

Island peoples often make a living from fishing. By virtue of its versatility bamboo can supply a great many of the fisherman's needs. This has been demonstrated dramatically by the Chinese. If one looks up names relating to fishing in a Chinese dictionary it will be found that a great many of these complex terms (ideographs and pictographs) contain the symbol for bamboo. This fact signifies that even before their names were first reduced to writing, bamboo was employed in the making of the devices themselves. To mention only a few of them: traps, weirs, sluices, barriers, poles for hook-and-line fishing, spears, sea-anchors, floats, trays and poles for drying fish and baskets for transporting them, netting needles, poles for drying nets, punting poles, scaff-or dip-nets, including karojals, salambas, etc. The dredges, punting-poles, sieves and sea-anchors of oriental clam-dredging equipment are all made of bamboo.

Other uses may interest other sections of the population. Living plants of bamboo with suitable growth habit may be used for hedges, screens and windbreaks. Culms from certain bamboos may be used to build houses, granaries, bridges, fences, corrals; furniture and household utensils of all descriptions; rain gutters and water-conducting pipes. They can supply withies for the fabrication of cables, both heavy and light, and woven ware such as basketry, matting, sieves and trays. Coarser strips make sturdy crates for shipping pigs and poultry and garden produce; excelsior-like scrapings serve for stuffing pillows and mattresses, for caulking boats and toughening plaster. Refined fibres yield cellulose for paper or rayon; crude fibres are used for making cordage and sandals. Poles of various sizes are used for making ladders, lining-out poles, stakes for supporting trees, tool handles, rakes and miscellaneous garden needs.

Uses for foliage

The foliage of many bamboos is used as a major or supplementary source of fodder and bedding for livestock. The unopened leaves are used to make a cooling tea, probably rich in vitamin C. The branches of certain kinds make excellent brooms for outdoor sweeping. The culm sheaths, when of suitable size and texture, find many uses: lining sun- and rain-stopping hats, awnings and shipping baskets, and for making sandals. In India, the hard, even-grained rhizome of a common species of *Dendrocalamus* is used to make polo balls.

An objective which will have validity and pertinence, in the light of the foregoing observations, is that of locating and assembling an ample array of those kinds of bamboos that give promise of thriving here and there under given local conditions, and at the same time present technical characters that fit them for exploitation somewhere along the wide range of uses that has been cited.

Once established under favorable environmental conditions, bamboos generally require little or no attention beyond occasional thinning to keep the clumps in vigorous condition. If they are sufficiently well adapted, they will not die from lack of care, and they will always be there for experimental studies, propagation, and for future use if and when changing conditions or new technical developments open the way for additional channels of exploitation. It seems reasonable to suggest that living collections should be studied in a wide variety of ecological conditions, keeping in mind the dual function (production and conservation) as well as the basic principles of land utilization. After production has become commensurate with the local needs it may be desirable to undertake to supply outside demands as well.

Control of Brush and Undesirable Trees: II

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This article represents the second section of a paper which has been prepared at the request of FAO. The first section appeared in Unasylva, *Vol. 10, No. 1, together with a list of species mentioned and literature cited; the further sections will appear in succeeding issues of* Unasylva. *The whole series, when completed, will be made available under a separate cover.*

Equipment for Mechanical Brush Clearing

Large-scale efforts to control undesirable woody species has awaited mass production of machinery to do the job effectively and economically. Our modern age of large-scale operations tends to overlook, however, that many small-scale efforts, using home-made hand tools, might do the same job more effectively and more economically. Time and personal convenience are the main differences between the two. Both types of equipment are discussed in this section.

The equipment is briefly described and illustrated with photographs or drawings wherever possible. The comparative advantages and limitations of each piece are enumerated and, so far as possible, the approximate costs per acre for certain stipulated conditions are cited. Except when specifically discussed, it will be assumed that for larger vegetation, heavier pieces of equipment would be used.

Tractor-powered Machinery

Bulldozers

The bulldozer is the standard machine for the removal of brush and trees. It is a tractor equipped with a heavy pusher blade in front, which can be raised or lowered by hydraulic or cable control (Figure 8). The blade has a high concave moldboard with its bottom edge fitted with a steel-hardened, knife-like member which projects out ahead of the blade. The manner in which the blade is hinged to the pusher arms and lift rods differs in the many commercial models. Although the dozer blade is usually associated with a crawler-type tractor, blades fitting most wheel-tractors are available (*24*).[1]

[1] The references to literature cited were given in *Unasylva* Vol. 10, No. 1, with the first part of this paper.

Figure 8. *Bulldozer clearing woodland in Missouri. The bulldozer consists of the tractor, tool bar, and front blade. The tractor shown has about 35 horsepower at the drawbar.*

Caterpillar Tractor Co.

When clearing brush the bulldozer is used in two ways. One procedure is to hold the blade to the soil surface or a little below it, thus uprooting most of the larger stems while breaking off the smaller, brittle material. The brush is either left lying in place or pushed into piles or windrows. This method results in much soil disturbance. The grassy cover is frequently broken, huge holes are left where tree roots have been excavated, soil is pushed up in heaps around brush piles, and much of the land is temporarily bared of litter. On erodible sites in particular, such practice should be avoided. The other procedure is to "walk over" or mash the brush with the blade held from a few inches to a foot above the ground. The litter is left in place and is scattered uniformly over the soil surface. Where the brush is brittle, the tractor tracks tend to mulch the brush stems even more. This method does not work well in young brush which springs back to its original position after the dozer has passed over or in stands having numerous large trees which must be cut by some other method or else uprooted. If the land is burned after bulldozing, it is advantageous to have the ashes scattered evenly over the area. Mashing followed by burning is a common practice on rangelands in California and elsewhere.

For reasons already discussed, only approximate cost figures can be given for bulldozing. Several examples follow. In Texas, in 1946, bulldozing of heavy stands of brush, not including piling or windrowing, cost from $8.50 per hour for light tractors to $15.00 for heavy tractors. On a per-acre basis, this is from $11.00 to $14.00 ($27.50 to $35.00 per ha.) depending on the brush (*19*). Heavy bulldozers are more expensive to operate by the hour than light ones but may be much cheaper by the acre since they are more efficient. In California, in 1955, the average cost per acre in brush which can be knocked down and pushed into windrows in one continuous forward movement is about $10.00 ($25.00 per ha.) (*6*). For heavier and denser brush the estimate per acre is from $10.00 to $20.00 ($25.00 to $50.00 per ha.) and in full density stands, where much backing and turning is required, the costs may run from $20.00 to $50.00 per acre ($50.00 to $125.00 per ha.).

Brush piling equipment

After the brush has been mashed or cut by bulldozers or tree dozers, specially designed rakes may be used for piling. Such brush rakes or bull rakes lift up the brush, allowing the soil to fall down through the teeth of the rake. The soil which still clings to the roots can be knocked loose by lifting and dropping the load several times in rapid succession. When the brush is to be burned, a good method, facilitated by the rakes, is to pile brush as it is being burned. In this way, more of the coarse stems are consumed than if all the piling or windrowing is done first and then burned.

Buck rake (Figure 9). A modification of the hay buck rake is made, attachable either to wheel or crawler-type tractors. The teeth of the rake are made of 2-inch (5 cm.) pipe which will bend without breaking

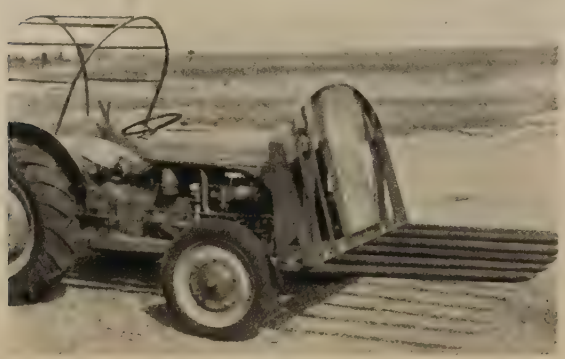

FIGURE 9. *Power-lift buck rake. This rake can be attached to any small farm tractor. The rake shown is 5 feet (1.5 m.) wide and the teeth are 4 1/2 feet long. The small size is an advantage for maneuvering in close places.*

Okla. Agr. Expt. Sta.

FIGURE 10. *Brush rake or "stacker" piling brush and trees. This model is made by Florida Land Clearing Equipment Corporation (FLECO), Jacksonville, Fla. The tractor photgraphed is a 155-horsepower Caterpillar Diesel. Other sizes of rakes are available.*

Fleco Corporation

FIGURE 11. *Tree dozer pushing over large oak tree. After the tree is leaning the blade is lowered and the roots are severed at the ground level with the knife at the bottom of the blade. This is an AFCO tree dozer attached to a 230-horsepower Caterpillar tractor.*

Caterpillar Tractor Co.

when a stump or stone is struck. Overloading on a tooth will cause it to bend down without breaking, and the neighboring teeth take up part of the load.

Rakes attached to wheel tractors generally do not have enough clearance below the rear end of the frame when brush is moved across fields with high stumps and snags. When lifted high, a 1,000 pound (455 kg.) weight of brush will give the tractor poor balance while in motion. Crawler tractor equipment is generally more efficient on rough brush lands.

Brush rake (Figure 10). The brush rake or "stacker" consists of a concave moldboard, similar to that of a bulldozer, a top guard to prevent limbs from damaging the radiator of the tractor, and teeth extending below the moldboard and slightly forward. The teeth are fitted with skid shoes. Gathering springs on either side of the rake increase the load carrying capacity. Since the teeth are shorter than those of the buck rake and not held horizontally, the brush can only be pushed forward and not lifted. However, there is enough clearance between the teeth and under the moldboard to permit dirt-free piling.

Grubbing equipment

A number of devices which can be bolted to the dozer blade or attached to the tool bar or pusher arms in place of the ordinary concave blade serve to perform specialized tasks in brush clearance. When attached, these pieces inherit the stability and strength of the bulldozer and also its mobility. Grubbing of roots

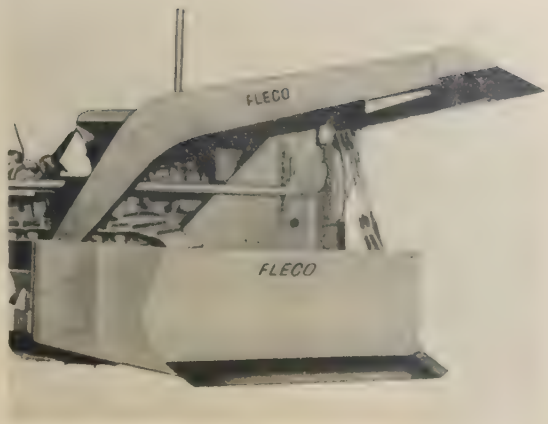

FIGURE 12. *Tree dozer. The knockdown beam and blade on this model are operated independently by double-drum cable control. It fits the larger Caterpillar tractors.*

Fleco Corporation

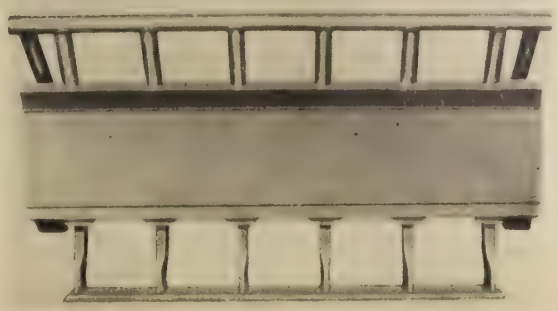

FIGURE 13. *Tree cutter. The sharp steel blade slashes through 16- to 20-inch trees after the tension bar above bends the tree over. The tree cutter is available for all sizes of Caterpillar and other crawler-tractors.*

Fleco Corporation

FIGURE 14. *Root cutter. Operating in mesquite. The roots are being severed well below the bud zone of the crowns. The tension bar pushes the plant over. The tractor is a 90-horsepower International Diesel.*

Texas A. and M. College

FIGURE 15. *Pull-type root cutter. Tractor is 150-horsepower Allis-Chalmers Diesel. This implement is very effective in mesquite.*

Texas A. and M. College

FIGURE 16. *Detachable stumper. This equipment fits on the C-frame of any angling dozer.*

Fleco Corporation

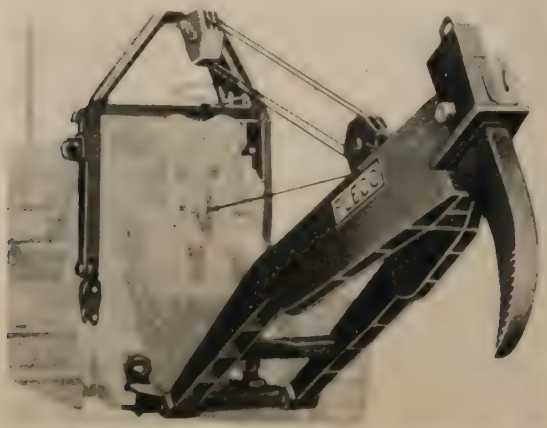

FIGURE 17. *Pull stumper. This equipment is attached to the rear of a tractor and is operated by a cable control unit hung from an A-frame.*

Fleco Corporation

and stumps, often 18 inches (45 cm.) or more underground, exerts much more strain on machinery than surface equipment receives. For this reason these grubbing implements are simple, massive pieces which do not break readily. A few of the grubbing implements to be described are pulled behind the tractor.

Tree dozer (Figure 11). The tree dozer has a huge push-bar or bumper extending far out in front of a V-shaped blade. After a tree has been pushed over with this bar, exposing the roots, the blade is lowered and the roots are freed from the ground with the sharp cutting edge on the bottom of the blade. The bumper or "knock-down beam" of some models is controlled independently from the cutter blade or plow below (Figure 12).

Tree cutter (Figure 13). The tree cutter is useful where stems are large and where stumps cut flush with the soil surface are not objectionable. Trees up to 20 inches (50 cm.) in diameter can be cut. If there are no larger than 12-inch (30 cm.) trees or shrubs in the stand, a 10-foot (3 m.) swath — the width of the blade — can be cut with the tractor in third gear, without any backing or turning. The tension bar at the top extends forward beyond the cutting blade. It bends the tree, putting the fibers under tension. The blade at the bottom, which is mounted on heavy duty standards, then slices through the trunk.

Root cutter (Figure 14). This consists of a short blade set between two heavy steel supports. These supports slope back toward the front of the tractor so that the blade makes first contact with the root or stump. The blade digs deeply enough to cut below the bud zone. Since the entire attachment can be lifted by hydraulic control just like a bulldozer blade, brush plants or whole trees can be lifted right out of the ground after the roots are cut.

Pull-type root cutter (Figure 15). This operates on the same principle as the previous root cutter except that it is pulled behind the tractor. It cuts 12 to 18 inches (30 to 50 cm.) below the soil surface. The blade is V-shaped, which makes it easier to pull through the subsoil. The width of cut is about 11 feet. The blade can be raised or lowered either with hydraulic or cable lift. The rig shown in the photo plows approximately 2 acres (0.8 ha.) per hour at $10.00 per acre ($25.00 per ha.).

Stumpers. Two types of implements are known as stumpers. The detachable stumper in Figure 16 is attached to the front of a dozer frame. It is cast from one piece of steel. The four teeth are hard-faced and provide a biting width of 30 inches (75 cm.). The stumper is driven into a stump where the teeth hold it fast. Then, by forward motion combined with hydraulic lifting, the stump is uprooted. The pull stumper (Figure 17) attaches to the rear of the tractor and is

operated by cable control. The tooth is also one-piece cast steel, securely fastened to a heavy duty frame. It can be used to cut lateral roots 3 feet (90 cm.) deep as well as for pulling stumps.

Stinger (Figure 18). The stinger blade is a modified stumper. It is a narrow plate attached to the center or one side of the dozer blade. It extends below the blade about 12 inches (30 cm.) and slightly ahead of it. The stinger digs out small trees and shrubs which cannot be forced out by the bulldozer or tree dozer. The single tooth concentrates the full power of the tractor on a narrow front.

Juniper bit (Figure 19). This eight-toothed, heavily reinforced bit was especially designed for lifting large shrubs, such as juniper, out of the soil in one operation. It is bolted securely to one side of the moldboard and to the cutting blade of the dozer. The other side is used as a regular bulldozer for pushing down smaller brush.

Root rake (Figure 20). The root rake or grubber blade has 6 to 8 teeth extending forward and below the cutting blade of a dozer. This implement is used most effectively for "combing" roots out of the soil after the larger trees have been cut down and uprooted. It can also be used for piling. Rakes work best in dry or sandy soils. Sticky soils may clog up ahead of the teeth. The photograph was used to illustrate the fact that none of the "heavy duty" implements are rock-proof.

One of the chief advantages of the various forms of toothed attachments over the regular bulldozer blade is that they actually move little soil. In order to give the same grubbing action at a depth of 12 inches (30 cm.), the solid dozer blade would gouge out a foot of soil which would be carried along for some distance by the moldboard. In the root rake, stinger, and horizontally held blades, the soil can sift around the teeth or over the blade and no soil movement occurs. The effect on the soil is similar to that of a subsoil tiller used on agricultural lands. Frequently the soil is so loose that it is a poor seedbed for grasses unless it is packed or rolled.

Grubbing devices are used when sprouting species are involved and where it is desired that no obstacles remain in the soil which would be harmful to future farming practices. In such cases, two or more kinds of equipment may be used in the same brush-clearing operation. For example, in Texas shrublands, a common practice is to clear the brush in four steps

1. knocking brush down with bulldozer or tree dozer;
2. piling with bull rake;
3. root plowing — cuts the roots at 12 to 18 inches (30 to 50 cm.) under ground and elevates them to the surface;
4. root piling.

FIGURE 18. *Stinger digging out mesquite bush. It is attached to the C-frame of an angling dozer.*
Texas A. and M. College

FIGURE 19. *Juniper bit bolted to one end of dozer blade and moldboard. Bit is attached to Cletrac tractor.*
U.S. Soil Conservation Service

FIGURE 20. *Root rake "combs" roots out of soil. It can also be used for piling.*
Texas A. and M. College

FIGURE 21. *Standard disc plow. This model is made by the John Deere Implement Co.*

U.S. Forest Service

FIGURE 22. *Heavy duty offset disc harrow. The heavy duty models are designed primarily for brush control purposes.*

U.S. Forest Service

FIGURE 23. *The wheatland-type plow. This plow is a slight modification of the disc used on farm land in the Great Plains. It is well adapted to sagebrush eradication.*

U.S. Forest Service

Approximate time and costs for each part of the complete operation in 1946 were:

1. 4/5 to 1 acre per hour, $11.00 to $14.00 per acre (0.32 to 0.4 ha. per hour, $24.50 to $35.00 per ha.);
2. 1 1/4 to 1 1/2 acres per hour, $6.00 to $8.00 per acre (0.5 to 0.6 ha. per hour, $15.00 to $20.00 per ha.);
3. 3/4 to 1 1/4 acres per hour, $11.00 to $13.00 per acre (0.3 to 0.5 ha. per hour, $27.50 to $32.50 per ha.);
4. 2 acres per hour, $11.00 to $13.00 per acre, totaling $35.00 to $45.00 (0.8 ha. per hour, $27.50 to $32.50 per ha.) for the whole procedure (*19*).

Disc harrows

A number of types of disc harrows (also called disc plows or simply discs) have been developed especially for brush control work. Their construction is based largely on the principles of the standard farm disc. The disc harrow is designed to accomplish three purposes in brush control: kill the plants, mulch the stems, and prepare a seedbed. The implement is essentially a series of concave discs with sharpened edges so placed that a cutting and loosening action is obtained. It may or may not be mounted on wheels.

Although the standard disc plow will be described first, the most effective variations of the implement for brush clearing are the offset disc harrow, the wheatland-type plow, and the brushland plow (*40*). Another variation — the eccentric disc plow or range pitter — can be used for brushlands but was built primarily for another purpose.

Standard disc plow (Figure 21). This plow has a single gang of disks, up to six in number, each with its own bearing. The discs are set obliquely to the vertical, and usually some adjustment of the angle can be made for different plowing conditions. The frames are mounted on wheels which makes it possible to adjust the depth of plowing.

The disc plow is not very effective in stands of dense brush but is useful for plowing heavily sodded meadows which have species with thick, tough taproots. It works much like a moldboard plow but will scour better in heavy clay soils and can penetrate soils which are too hard or dry for the moldboard plow.

This implement is costly to operate. The width of cut is relatively narrow — 54 inches (135 cm.) for a six-gang plow — and takes at least a 60 to 70 horsepower tractor to pull it. The plow cannot be used on land with large imbedded rocks.

Offset disc harrow (Figure 22). The offset disc is so named because it can be set to run either to the right or left of the center line of the tractor which pulls it. It is a two-way disc which has no wheels, hence the entire weight of the implement rests on the blades. Two gangs, each mounted on separate frames, are situated one ahead of the other. The front gang throws the soil in one direction, the rear in the other. Depending on the kind of brush or soil involved, added weight and durability are incorporated in the construction by using heavier frames. The United States Forest Service has developed several models of the offset disc harrow for sagebrush control work in the western United States. They differ chiefly in the weight of the frame. One model has scalloped edges on the disc blades (Figure 1).

The offset disc harrow is effective in removing sagebrush and other low-growing, brittle forms of brush.

FIGURE 24. *The eccentric disc used for pitting. The alternate discs are off-center. In operation, the machine scoops out shallow intermittent pits, leaving a "waffleized" surface that catches the rainfall and stimulates grass production.*

Soil Conservation Service

FIGURE 25. *The brushland plow. This plow was developed principally for killing sagebrush preparatory to seeding on rough, rocky range lands of the western United States. It was developed by the U.S. Forest Service equipment laboratory and is not yet in commercial production. Plans can be obtained from the U.S. Forest Service, Washington 25, D.C.*

U.S. Forest Service

The implement can be weighted down with rocks if the soil is too firm, but this puts much strain on the frame and discs so that excessive breakage is imminent. Breakage is also high on rocky areas, causing chipping of blades and broken arbor bolts. Depth of penetration is difficult to regulate. Power requirements vary with the soil, size of brush, and weight of the implement. An extra heavy duty 10-foot (3 m.) model needs an 80-horsepower tractor; a 6-foot (1.8 m.) light duty harrow can be pulled with a 20 horsepower tractor on level ground. Other advantages of the lighter equipment are lower cost of construction and easier transportability.

The offset characteristic is of no special advantage on brushlands except where it is desired to disc under low hanging branches of trees. Usually it is hitched to the center of the drawbar.

Wheatland-type plow (Figure 23). This is a single gang, one-way plow. It consists of a series of vertical discs spaced along a common axle, all of which revolve as a unit. The axle is at an angle of from 35 to 50 degrees with the line of travel. The implement is mounted on three wheels, which allows leveling and depth adjustments to be made.

In brush eradication the wheatland-type plow is best suited for use on relatively rock-free ground. Kills on sagebrush in western United States have been as high as 95 percent. It will kill 5 to 10 percent more sagebrush than the heavy duty offset disc harrow. The adjustable plowing depth makes it convenient to use in areas where brush density or soil compactness varies from place to place. But because of the number of adjustments and the lighter frame, the implement is easily broken and more care is required than with the offset disc.

A 40-horsepower tractor will pull a 9-foot (270 cm.) plow on level ground. The machine as now built weighs about 300 pounds per foot (100 lb. per m.) of cutting width. A seeder box attachment is available.

FIGURE 26. *Pipe harrow. This is a self-clearing harrow which has been found useful for clearing sagebrush and covering grass seed on ranges that are so rocky and rough that other implements cannot be used. Plans for its construction can be obtained from the U.S. Forest Service, Washington 25, D.C.*

Oregon Extension Service

Eccentric disc plow (Figure 24). This plow also has a single one-way gang. Every other disc is mounted about 2 inches (5 cm.) off center on the axle or gang bolt. These eccentric discs are spirally arranged so that every fourth eccentric disc is cutting at its full depth at any one time. The discs in between have true centers. This arrangement decreases the machine's effectiveness in brush removal but leaves the soil pitted with 3-inch holes — from 6,000 to 7,000 per acre. These pits hold excess surface water following rainfall which

FIGURE 27. *"A"-rail: this type of rail throws the brush into windrows around the end of the side members. Railing equipment is not sold commercially but can easily be made in any farm shop from available materials. Designs and specifications for the "A"-rail and the Supp rail shown in Figure 28 can be obtained from the U.S. Forest Service, Washington 25, D.C.*

U.S. Forest Service

FIGURE 28. *Supp rail. This rail rides over the brush and leaves it scattered uniformly on the soil surface.*

U.S. Forest Service

FIGURE 29. *Chaining mesquite in Texas. Two 155-horsepower tractors pull about 200 feet (60 m.) of heavy chain across level range land. The chain has already been dragged in the opposite direction. Heavy cable would be just as effective.*

Caterpillar Tractor Co.

in turn is beneficial to the growth of rangeland vegetation (*3*). The wheatland-type plow can be converted into an eccentric disc by placing every other disc 2 inches (5 cm.) off center.

Brushland plow (Figure 25). The brushland plow was designed especially for rough, rocky land. The principles of plowing are the same as those for the previous types of disc harrows. Here, however, the discs are mounted in pairs. Each pair is held in the ground by spring tension. Thus, when a rock, stump, or heavy root obstructs the way, the pair of obstructed discs can raise up while the others continue to operate.

The discs of a pair are of two sizes. The forward disc is 28 inches (70 cm.) in diameter and the rear one, 24 inches (60 cm.). With two different peripheries, the discs have a slicing action as they roll forward and hence are more likely to cut the brush roots instead of rolling over them. When a pair of discs are raised, the blades become straightly aligned, which results in more of a rolling action over rocks than scraping. As a consequence, there is less strain in the edges and disc arms.

The brushland plow is made with a heavy steel frame and weighs about 3 tons. It has a 10-foot powered cutting width and can be pulled with a 40-horsepower crawler-type tractor on fairly level ground. Its advantages over other types of equipment are the low maintenance and breakage costs even when used on rocky land. In the sagebrush country, kills of 100 percent have been obtained on areas with few rocks and 90 percent or more on rocky areas.

The machine as now constructed costs about twice as much as the offset disc harrow or the wheatland-type plow of the same cutting width. Because of its weight, it is difficult to transport. A detailed account of the construction and limitations of the brushland plow can be found in (*8*).

Harrows

Pipe harrow (Figure 26). The pipe harrow or Dixie drag was built for the removal of mature sagebrush on very rocky land. It consists of a series of pipes beset with steel spikes, dragged behind a horizontal spreader bar. Each pipe is swiveled so that it rotates freely and cleans itself of stems and clods. It bounces over the rocks, spins, rips out brush plants, gouges into the soil, and covers seed where enough soil is present. In the process it removes from 50 to 70 percent of the sagebrush. The rockier the ground — up to a point — the better it works and cleans itself.

The pipe harrow does not approach the various disc harrows in effectiveness, either as to kill of brush or to seedbed preparation. As stated, however, it is specifically designed for use on land too rocky for these latter implements to work without excessive breakage. The pipe harrow is a sturdy implement. Breakage is uncommon but the spike teeth and the swivels wear out in time. A 14-foot (425 cm.) unit can be pulled by a 50-horsepower tractor. If two harrows are used side by side, they can be pulled with an 80-horsepower tractor, although a heavier one is more efficient. On side slopes, the harrow should be equipped with troughs to keep them from jumping across one another.

Other harrows. The spring-toothed, spike-toothed, and rotary harrows are useful in covering seed after brush clearing and broadcast seeding of range lands but are of little value in the clearing operation itself.

Rails and cables

One of the oldest methods of removing brush on a large scale is that of dragging heavy objects such as railroad rails, cables, or chains behind tractors. Rails are especially effective in stands of the brittle-stemmed brush, such as big sagebrush in the western United States. Chains and cables can be used to advantage for considerably larger plants.

Many variations of design for rails have been used, with different degrees of success. After tests made on sagebrush by the United States Forest Service, two designs are especially recommended (*40*).

"*A*"*-rail* (Figure 27). As the name indicates, the "A"-rail has an A-shaped frame made of welded railroad rails which is pulled with the apex forward. Not evident in the photograph are two rolling coulters attached to the side rails at or near the position of the extremities of the crossbeam. These cut through debris which tends to accumulate in the angles made by the crossbeam and complement the rail in rolling over the vegetal material instead of dragging it along.

Supp rail (Figure 28). The Supp is a straight rail made out of three sections aligned side by side and perpendicular to the line of travel. Flexible couplings connect the sections. It is necessary to attach drag rails or posts to the ends of each of the sections. This gives the front rails more weight and keeps the entire implement from bouncing around, and it is kept aligned more easily. Recommendations are that these be at least 10 feet (3 m.) long, as compared with the 33-foot (10 m.) combined width of the front rails.

Under normal conditions rails require from 1.5 to 2 horsepower for each foot of width. The designs shown in Figures 27 and 28 are made for a 40-horsepower crawler tractor.

Where the brush stand is mature and brittle and the ground fairly even, rails are excellent for removing the brush cover, but they do not prepare a good seed bed for sewing grasses and, unless the soil is already loose, seed coverage by railing is not adequate. Large areas can be railed in a day at low costs. Most grasses are not damaged unless they are prominently pedestaled perennials. Much broken debris is left scattered uniformly over the ground to protect the soil from water and wind erosion. Rails are not effective in young, springy brush and on areas having many boulders and rock outcrops.

FIGURE 30. *Roto-beater. This is a multi-purpose device which can be used for mulching up vegetables, cover crops, weeds or small brush. For brush, special heavy duty flails are used and rotor speed is geared to 1,375 revolutions per minute. Standard models are driven by power-take-off units but independent power is better since the rotor retains full speed even when the forward drive is slowed down over rough terrain. Made by the Olson Manufacturing Company, Boise, Idaho.*
Calif. Division of Forestry

Breakage most commonly occurs where the rail sections have been welded together. These places should be strongly reinforced when the rail is reconstructed. It is better to use new railroad rails than used ones

FIGURE 31 a. *The bushwhacker. View of disintegrator head with flails exposed.*
Texas A. and M. College

FIGURE 31 b. *The bushwhacker in action on a large tree. Distributed by the Willis S. Martin Company, Lincoln National Bank Building, Fort Wayne 2, Indiana.*
Texas A. and M. College

FIGURE 32. *Gyro-brush cutter. Made by the Servis Equipment Company, 1000 Singleton Boulevard, Dallas, Texas.*

Texas A. and M. College

FIGURE 33. *Giant stalk cutter. This model is called the Marden Duplex. Made by the Marden Manufacturing Company, Auburndale, Florida.*

Oklahoma Agr. Expt. Sta.

FIGURE 34. *Portable brush grinder. Made by Mitts and Merill Incorporated, Saginaw, Michigan.*

U. S. Soil Conservation Service

which may break because of crystallization. One advantage of rails over other kinds of brush-clearing equipment that should not be overlooked is that they can be constructed in any well-equipped machine shop. The railroad rails can be obtained anywhere.

Chains and cables (Figure 29). In cabling, a long heavy cable or chain trails in a loop behind two tractors traveling along a parallel course. The cable is suspended near the middle of its loop on one or more heavy doughnut-shaped weights. This keeps the cable on the ground over its entire length. Two 155-horsepower tractors traveling 100 feet (30 m.) apart can pull 300 feet (70 m.) of 1 ½-inch (3.75 cm.) cable or 2-inch (5 cm.) chain with weights, and cover about 100 acres (40 ha.) a day. Cabling should be done in two directions: on the first trip the brush is bent over in the direction of travel and on the return trip it is uprooted.

This method has been found to be more effective on larger plants, such as juniper and mesquite which attain 20 feet (6 m.) or more in height, than on smaller flexible shrubs. Cabling is not efficient unless the area is large and the terrain is fairly level. Cost per acre for cabling alone is less than that of a bulldozer, in spite of the need for two tractors. However, the range is messed up with the many large uprooted plants which must be removed with rakes, bulldozers, or fire before full use can be made of the area.

Brush choppers and beaters

A varied array of ingenious machinery has been designed to reduce brush and trees from the status of a formidable thicket to a level, uniform cover of mulch. The mechanical principles of these devices differ considerably but the result of their work is much the same. Brush stems and tree trunks are finely chopped up and deposited on the soil surface. There is no grubbing action, and except where plants are uprooted as they are pushed over by the frames of the machinery, the soil is little disturbed. The chopped material can be burned or left in place as a mulch.

Many small equipment companies manufacture brush choppers which are sold locally, these being designed especially for the kinds of brush of the immediate vicinity.

Chain beater. This implement was designed for use in brashy forms of brush such as sage, creosote bush, or shinnery oak (*12*). It works somewhat like a hammer mill. A series of weighted chains are driven by a horizontal shaft which revolves at high speed. The shaft is mounted on a frame supported by two wheels. The chains are slightly over 2 feet (60 cm.) in length, spaced 3 inches (7.5 cm.) apart, and are attached to the quarter lines around the shaft so that the weight is evenly distributed. Welded to the extremities of the chains are heavy iron beater heads. These clear the ground by several inches. The chain shaft is driven by the power take-off of a tractor and is geared to make about 380 revolutions per minute when the tractor is at full throttle. This optimum speed is primarily determined by the accuracy of balance for the machine. Shorter

FIGURE 35. *Power saw cutting mesquite tree. Tension bar keeps tree from falling towards tractor and prevents "pinching" of saw blade. Model shown is made by the Jacques Power Saw Company, Denison, Texas.*

U.S. Soil Conservation Service

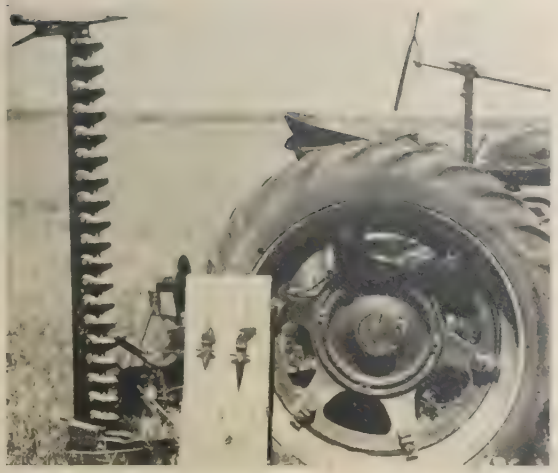

FIGURE 36. *Tractor power mower. The cutter bar has been equipped with stub guards and additional hold-down clips. On board are shown (left) stub guard and (right) standard guard.*

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chain lengths will permit higher gear ratios. When an obstacle is struck, the chain wraps itself around the shaft and then unwraps again.

An effective variation of the chain beater is the roto-beater, described and illustrated in Figure 30 (a and b).

Bushwhacker (Figure 31). The bushwhacker is a huge machine consisting of a standard crawler tractor on which is mounted a rectangular steel frame. This frame is pivoted at the approximate longitudinal center of the tractor on a heavy steel shaft running through the tractor chassis. A flail-type disintegrator is built into the front of the frame and is powered by a 175-horsepower Diesel engine mounted at the rear. The disintegrator is further supported by a pair of gauge wheels which move solely in a vertical plane. By raising or lowering these wheels hydraulically, the height of cut is regulated, from 1 inch (2.5 cm.) below ground level to 17 inches (42.5 cm.) above. This amount of clearance is necessary when in operation to avoid rocks and to level large trees. The whole unit, including the gauge wheels, can be raised higher to knock down trees and for traveling by pivoting the frame on its center mounting (*24*).

The flails in the disintegrator head are made of hardened steel castings and are attached to a drum by 1 1/8-inch round links. Twenty flails are staggered on the drum to present a continuous cutting edge 6 feet wide. The flail heads are 6 1/2 inches (16 cm.) wide, weigh 19 1/2 pounds (9 kg.), and travel around the drum at a speed of 11,550 feet (5,150 m.) per minute. Since the flails are attached to the drive shaft with links, there is a certain amount of resilience which reduces damage from rocks.

The bushwhacker moves into the standing brush or small trees, a deflector bar bends them over, and the flails rupture all the woody fibres that they contact. The shredded material is then spread out evenly in the back by means of a skirt. This skirt also keeps limbs and large chunks of wood from escaping the flails.

The limitations of the bushwhacker are stem diameters and ground conditions. Practical ranges for hardwoods are 5 to 6 inches (12.5 to 15 cm.) in diameter and for soft woods, 5 to 8 inches (12.5 to 20 cm.). Rough, rocky terrain minimizes the mechanical effectiveness. Presence of loose rocks and boulders necessitates raising of the general cutting height, which in turn leaves much unshredded debris on the ground. In medium to heavy brush density, the machine moves forward in low gear at about 1 1/2 miles (2.4 km.) per hour. At this rate it will clear an acre in one hour of continuous operation. Cost of operation per hour is not known; in arriving at an estimate in comparison with bulldozing, for example, it must be remembered that two Diesel engines are in use. The machine is expensive and small jobs or occasional use would not justify its purchase. However, when much work is to be done, the cost per acre is low considering its high efficiency in brush clearing and disposal in the same operation.

Gyro-brush cutter (Figure 32). This cutter has two heavy blades which are actually one solid iron bar about 1/2 inch (1.25 cm.) thick and 4 inches (10 cm.) wide attached to gears at the center. The blades rotate in a horizontal plane at high speed. Clearance above ground is adjustable up to 14 inches (35 cm.). The machine is supported on two wheels but the blades are propelled by the power take-off of the tractor. Total weight is approximately 1,400 pounds (685 kg.). The gyro cutter works on the same principle as a rotary lawn mower. When a rock is struck a pin is sheered in the clutch and this is easily replaced. The chief draw-

FIGURE 37. *Chain saw in action. This saw weighs about 25 pounds. It is powered by a two-cycle, air-cooled gasoline engine. The blade is adjustable to any position. This makes it as useful for pruning and cutting up stems as for sawing trees. The model shown is made by the Lombard Governor Corporation, Ashland, Massachusetts.*

Berg-Marshall, Inc., Worcester, Mass.

FIGURE 38. *Portable circular saw for small diameter trees. The model shown is called the brush-cut attachment which fits the chain saw unit after the cutter bar, chain and sprocket are removed. Circular blades are available up to 14 inches (35 cm.) in diameter. Made by the Lombard Governor Corporation.*

Berg-Marshall Inc., Worcester, Mass.

back with this machine is the relatively low clearance. It works best in low, brashy brush where the stems seldom exceed 1½ inches (3.75 cm.) in diameter.

Giant stalk cutter (Figure 33). The basic unit of the stalk cutter is a hollow steel cylinder around which are set 8 full-length sharp blades. A medium sized unit weighs 4,200 pounds (1,905 kg.) empty and 6,000 pounds (2,720 kg.) when the cylinder is filled with water. Large stalk cutters weighing 28,000 pounds (12,700 kg.) have been built. An articulated yoke gives the implement flexibility and permits its use on rough terrain. A simple coupling system allows for the use of two or more of the cylinder units side by side or in tandem. Several designs are commercially available.

Stems up to 2 inches (5 cm.) in diameter can be cut. It is a highly effective follow-up tool for breaking down small trees or brush which have been killed with chemicals for sprout control. The machine is also useful for preparing firelines.

Wood chippers (Figure 34). Several portable wood chippers or grinders are available. They are stationary when in operation and this decreases their usefulness in brush clearing work. They consist of a drum with blades turning at 1,000 to 3,000 revolutions per minute, and will take material up to 6 inches (15 cm.) in diameter, or 2,000 to 3,000 pounds (907 to 1,360 kg.) of brush per hour. The chips are blown out of a pipe either into a truck or onto the ground. Chippers are generally with a 20 or 30-horsepower engine attached to the unit but may be driven by the power take-off of a tractor. Their use is mostly confined to slash and brush removal in forests for fire hazard reduction, but not infrequently the purpose is to provide chips for logging roads and skid trails to prevent erosion.

Power saws and mowers

Tractor power saw (Figure 35). A number of manufacturers make saw attachments for tractors. The saws are either driven from the power take-off or the belt pulley of the tractor. In most cases the saws can be used for cutting brush and trees while the tractor is in motion but when large trees are encountered, the tractor must be stopped and the saw swung into the tree gradually. The tractor should be fitted with a guard to prevent limbs from crashing down on the operator.

It takes a skillful operator to make the sawing method efficient. It is difficult to keep the saw blade from striking the ground or recutting high stumps. Often the saw operator "saws" himself into a "corner" from which it is hard to extricate himself. For this reason it is advantageous to operate a buck rake along with the saw. As the brush and trees are cut, the buck rake picks them up and removes them. This gives the saw operator more visibility as well as maneuverability. In tests performed in Oklahoma, this two-machine method was used on a tract containing 8,470 brush stems up to 2 inches (5 cm.) in diameter and 133 trees up to 8 inches (20 cm.) in diameter. The operation required 2 ½ hours per acre (6 ¼ hours per ha.).

One of the disadvantages in the use of saws is the large amount of time spent in keeping the blades sharp-

FIGURE 39. *Mechanical tree girdler. This device can be used on any size tree; it cuts sufficiently deep to ensure complete separation of the cambium. Girdles are cut at walking speed around tree. Estimated to be 3 to 5 times faster than when conventional methods of girdling are used. The "Little Beaver" girdler shown is made by the Haynes Manufacturing Company, Livingston, Texas.*
Haynes Mfg. Co.

ened. The closer to the ground surface the stems are cut, the more quickly the blades get dull. Contact with soil, especially sandy soil, small rocks, and gritty particles in the bark wear the saw teeth down rapidly. As soon as unreasonable force is required to feed the saw into the stems, the blade is too dull to use. When the blade is only slightly dulled — ordinarily after every two or three hours of use in hardwoods — it should be touched up since this takes but a few minutes. But when allowed to get quite dull, more time is required for sharpening; in the meantime, the output of work has been decreased. Up to 80 percent of the efficiency of circular saws can be lost through dull blades. On large-scale or contract operations it is more efficient to have several blades which are changed in the field. Thus the tractor operator's time is not lost to saw sharpening.

Brush mower (Figure 36). Heavy duty power mowers, which are made like ordinary hay mowers except for heavier construction, can be used on many of the smaller forms of brush. An experienced operator can guide a power-driven mower through dense brush with stems up to 1½ inches (3.75 cm.) in diameter, providing the plants are growing vigorously. Larger stems must be cut one at a time or the forward movement of the tractor must be stopped to permit the sickle to hit the stems several times without much pressure from the cutter bar. It is better, however, to remove the larger stems another way than by sawing before the mower goes over the area. Many of the larger stemmed plants have a smaller cross-section a few inches up from the base; therefore if the cutter bar is raised on the shoes to a suitable height an advantage is gained, although stubble height will be greater. The tractor should be run in low gear and not throttled down, so that the sickle, which drives from the power take-off, runs fast in comparison to the forward motion.

Best results for brush mowing have been obtained with the 5-foot (1.5 m.) cutter bar, with stub guards instead of the standard length guards (see photograph), and with extra hold-down chips to keep the sickle from buckling. The sickle should have heavy duty, serrated sections. The amount of power transmitted to the cutter bar can be increased by keeping the slip clutch and safety release on the mower frame tighter than it is ordinarily set for mowing grass.

The economy in using this method for clearing brush is found in the fact that most farmers or ranchers already have a mower. With a few minor changes, it can be converted to a brush mower. The cost of buying and equipping an extra cutter bar with heavy sickle sections, stub guards, and the additional hold-down clips is only about $35.00 (Oklahoma, 1947). No other machine can be purchased for that price (*12*).

Portable Hand Tools

All of the things done by the various implements described in the previous section can also be done with a few simple hand tools: the saw, axe, machete, mattock, or pick. By comparison, their shortcomings are obvious, yet they have certain advantages. They are easy to obtain and inexpensive; they are simple to operate and, if broken, there need be little concern about replaceable parts. Such tools are most efficient where the number of plants to be removed per acre is very small. Examples are fields being invaded by scattered brush seedlings, open savanna where the woody plants are widely spaced, or coniferous forest where a small proportion of the trees are undesirable hardwood.

Between these simple tools and the tractor-powered machines are a number of engine-driven devices which can be carried and operated by one or two men. These include the chain saw (Figure 37), portable circular saw (Figure 38), tree girdler (Figure 39), and scythette. Other equipment of this nature is described in later sections on controlled burning and chemical brush control.

(*To be continued*)

Forest Protection in the U.S.S.R.

Summary of a Report Made to the FAO European Forestry Commission

Protection of the forests against harmful insects and diseases is one of the main problems before the U.S.S.R. Forestry Department. All forest protection work is based on the premise that measures for combatting harmful insects and diseases must be closely related to all of the Forestry Department's other work. In practice, this can be realized because the over-all control of all U.S.S.R. forests by a single administrative center permits the use of the Forestry Department's common administrative machinery for the organization of forest protection work.

However, for specific and special forest protection work there is also a special agency consisting of experts in forest pathology, each of whom serves five or six forest collectives. These are specialists with particular training in forest entomology and forest phytopathology.

The Forestry Department particularly stresses forest prophylaxis to keep the forests healthy and to create the conditions to discourage the spread of noxious insects and diseases; and planning, management and silvicultural practices are directed to this end.

Administrative policy takes into account the way in which insects and diseases may, in given circumstances, endanger the sound development of the forests. Planned measures are given effect by the units which carry out forest operations and exploitation in the field, in consultation with the forest pathology specialists, and they are aimed at the complete restoration of the forests, as well as to the creation of conditions discouraging the spread of harmful insects and diseases.

General regulations

The fundamental prophylactic measures for preventing the spread of harmful insects and diseases are given in *Regulations on the Sanitary Minimum in the Forests*. It is compulsory to follow these regulations in forest administration and forest exploitation.

Regulations on the Sanitary Minimum in the Forests establishes sanitary felling as compulsory. This applies to all felling in the forests and aims at the removal of trees liable to lead to population increases in harmful insects or the development of fungus diseases, and also aims at lessening forest fire hazards. For this reason sanitary felling includes the removal of dead timber and of trees whose trunks harbor insects such as bark beetles (*Ipidae, Cryphalus*), longhorn beetles (*Cerambycidae*), and oakborers (*Buprestidae*), clearing of damaged trees and of charred remains, slash and stumps which endanger adjoining healthy forests.

Likewise, one of the regulations forbids leaving unbarked timber in the forests over the summer. This rule obliges all logging camps to remove all timber felled in the autumn and winter period outside forest limits before 1 May; if the cut cannot be removed during this period, the timber must either be left barked or else stored by methods which preserve it from serious attack by insect pests. Timber accumulated in the spring–summer period must be shipped out of the forest no later than three weeks after felling, or otherwise also be barked or given appropriate preservative treatment.

In the past, the absence of proper sanitary methods in the forests has often created conditions favoring the mass increase of harmful insects and the spread of plant diseases, and therefore the application of these sanitary measures in the forests is now given exceptional significance.

Measures in the forest

Measures comprise a whole complex of agro-technical and protective measures promoting sound, well-developed forests and creating conditions discouraging the spread of harmful insects and diseases. Healthy forests are naturally resistant to big attacks. One of the preventive measures particularly widely encouraged is the protection of useful birds and attraction of insectivorous birds to the forests by erecting nesting-boxes. This latter work is made a supplementary assignment of the Forestry Department with the participation of the collective organizations and particularly schools.

The organized fight against harmful insects and forest diseases is based on systematic inspection for the appearance of symptoms or the spread of insects and diseases, timely notice of the outbreak of infection centers, and their correct diagnosis. For this purpose, field surveys, aerial surveys, investigations of mass increases in needle- and leaf-eating insects, and forest-pathological inspections are carried out. Systematic field survey and initial notice of the appearance of one or another insect or disease are the duty of the government forest wardens.

Aerial reconnaissance is the task of the fliers of the forest air warden bases; in every flight over forest areas they must watch for the appearance of large-scale damage in the forests which is visible from the air. Such cases of damage must be immediately reported. Air reconnaissance supplements ground surveys and is especially important in the vast forest concentrations of the North, Siberia, and the Far East, where regular air patrol service is used for detection of forest fires.

Ground and air surveys, however, only reveal infection centers when defoliation is already fairly advanced. Research has been devoted to the problem of working

out a survey method which would permit ready detection of the mass increase of defoliating insects at the very earliest stage, so that control measures could be started before serious damage or loss to the forests has been caused. Such a method, called stationary inspection, has been devised by the Soviet entomologist, A. P. Ilynsky. Widely practiced by the Forestry Department, the method is described in a government publication entitled *Surveying for Defoliating Broadleaf Insects in the Forests and the Prognosis of their Mass Increase.*

The method rests on the fact that mass increase of defoliators starts up in concentrated areas where conditions are most favorable for the insects. Such forest areas represent insect 'reservations' where the first foci of infection begin; the kinds of insects harbored depend on the tree species. A. P. Ilynsky has deduced factors which appear to govern a mass increase in the population density of insects, on the basis of which quantitative and qualitative indices for outbreaks of harmful insects have been compiled; the quantitative correlation of the site, fecundity of the females, rate of egg-laying and survival of the larvae, the absolute and relative insect population of the forest and the coefficient of increase.

By systematic inspection of the same area, calculation of the number of insects at particular stages of development, determining the heaviness of the oviposition, and by estimating the indications of the rising coefficient of increase, reliable judgments may be made on the insect's condition and the dynamics of its increase. A prognosis of the increase or the extinction of a mass increase of these insects can be made by comparing the indices over a consecutive period of years.

The stationary inspection is supplemented by general reconnaissance, which is now being carried out as a matter of routine under the forest warden service by the rangers in those forest concentrations where the presence of particular insect pests is most likely. The survey is made during the period when it is easiest to detect signs of the presence of the particular insects.

To calculate the spread of forest insects and diseases and determine the indications of the danger of their mass increase, forest pathology inspections are made both by Forestry Department specialists and interregional forest pathologists and by special inspection teams. The inspections provide the basis for the particular forest protection counter-measures to be undertaken, and are carried out in keeping with methods prescribed in special instructions.

Extermination measures

Of the measures for the extermination of defoliator attacks, dusting and spraying, especially from the air, has been particularly highly developed. In 1954, the area covered by aerial control was four times greater than the area covered over the entire period from 1937 to 1947. The airplane has considerable advantages over any ground equipment whose use in the forests is usually complicated and difficult, and in recent years there has been a greater availability of highly effective chemicals such as DDT and hexachlorane preparations in the form of dusts which have proved especially useful in combatting forest insects, particularly defoliators. The DDT dust is usually applied in concentrations of 5-10 percent and hexachlorane of 12 percent.

In the defoliator group the most important insects are *Dendroctonus pini*, *Dendroctonus sibiricus*, *Porthetria monacha*, *Butalis piniarius*, *Tenthredinidae*, *Porthetria dispar*, *Nygmia phaeorrhoea*, *Malacosoma neustria*, *Tortrix viridiana* and *Ophthera brumata*. There is a whole series of other harmful insects causing defoliation to conifers and broadleaved species, resulting in serious damage to forest production during years of mass increase in population density.

Chemical attack and aerial dusting with DDT and hexachlorane are widely practiced against this whole group during the period when the insect is in the earliest larval stage. As a rule, after the first three stages of growth, larvae and caterpillars acquire resistance to the chemical preparations, in proportion to the stage of growth, so that aerial attack in such periods becomes less effective.

The amounts used in aerial dusting of defoliators is 15-20 kilograms of DDT and hexachlorane per hectare, increasing to 25 kilograms in cases where the dusting is delayed (late in the season) or when the forests treated are particularly severely infected or damaged.

When treatment is timely and properly carried out, aerial dusting can lead to complete elimination of danger, since the destruction of the insect larvae and caterpillars generally amounts to not less than 95 to 98 percent.

Air operations, like other extermination measures, are always preceeded by a forest pathology survey, and the specific control project is drawn up on the basis of the survey's results. Special attention is paid to the condition of the insects and the activities of beneficial insects; predators and parasites of the noxious host are likewise taken into account with the aim of causing as little destruction of useful parasites as possible. The determining factor for achieving this aim is to concentrate the operation in that phase of the mass increase of the harmful insects either when the natural parasites show signs of reaching satiation point or when the larvae and caterpillars are in the earliest stages of growth; the majority of the beneficial insects generally attack the noxious hosts during later phases of development.

In recent years, chemical air attack has also yielded good results in combatting *Melolontha hippocastani*, which in a number of the regions of the U.S.S.R. has been found to cause serious damage to seedlings, saplings and shrubs in forest plantations and forest nurseries. Aerial dusting is done with hexachlorane during the summer period before the females deposit their eggs in the soil.

Soil-infesting pests

In recent years, other chemical measures have been devised for the protection of seedlings, saplings and shrubs and nurseries against larvae and caterpillars of harmful insects inhabiting the soil and damaging the roots, and are now widely applied in forestry practices.

In former years, many promising attempts to create new forests ended in failure because of the depredations of this group of harmful soil-infesting insects, which are more difficult to deal with because their larvae are less accessible than the defoliators.

The present practice requires that at the time of planting, seedlings must be protected with hexachlorane by one of the three following methods: powdering of the roots; submersion in suspensions; or powdering of the planting holes.

Hexachlorane protects the roots against damage for a period of two to three years and plants show no negative reaction when transplanted if certain conditions have been observed. A concentration exceeding 12 percent hexachlorane must not be applied to the soil immediately surrounding or touching the roots of the seedlings. In dry regions it is better to use suspensions or to powder the planting hole, whereas in the forest and partly in the plains-forest zones, direct powdering of the roots may be used. Planting with the application of hexachlorane should be done in the early spring while there is a great deal of moisture in the ground, in order to reduce the negative effect of hexachlorane on the plant.

DDT dust preserves the roots against damage for a two to three month period, and its use for chemical protection is therefore recommended only in years when the threat of beetles is particularly great.

In powdering the root systems of transplanted one-year seedlings 0.15-0.30 grams of hexachlorane (12 percent dust) or 0.5-1.0 grams of DDT (5.5 percent dust) per seedling is used. In the planting of two-year seedlings the amount of dust for each specimen is proportionately increased 1.5 times.

For immersion of roots in suspensions 0.2-0.4 grams of hexachlorane (12 percent dust) or 0.7-1.5 grams of DDT (5.5 percent dust) are used per one-year seedling. For preparation of suspensions for 1,000 seedlings, 200-400 grams of hexachlorane or 700-1,500 grams of DDT powder are taken, mixed thoroughly with a bucket of compost or of top-layer humus-treated soil and, constantly mixing, a bucket of water is poured into the preparation.

The powdering and immersion of roots in suspensions may be done by hand, as well as by mechanical means during planting operations, and likewise in planting tree grafts or shrub stock.

In powdering the planting holes, the amount used for each hole is 0.25-0.50 grams of hexachlorane (12 percent dust) or 0.7-1.5 grams of DDT (5.5 percent dust).

As regards dosage rates, the minimum is applied when the larvae present in the soil are in the first stage, under dry growing conditions, for the trees and shrubs that are more sensitive to hexachlorane such as *Larix*, *Pinus*, *Betula*, *Tilia*, *Quercus*, *Malus*, *Cerasus*, and *Acer platanoides*. The maximum rate is applied when the larvae are in the third stage of growth, for humid-growing conditions, for carbonaceous soils, and to trees and shrubs less sensitive to hexachlorane such as *Ulmus*, *Fraxinus*, *Populus*, *Robinia*, *Caragana arborescens*. *Rhus cotinus* and *Evonimus*.

In using dust of other hexachlorane or DDT content, a revision of the proportions is made.

To free the soil entirely from harmful insects, it is treated with 12 or 25 percent hexachlorane dust. The dust is introduced with the aid of a sowing machine or by hand sprinkling over the surface before the sowing or planting, and subsequently covered to a depth of 10-15 centimeters. When dust is sprinkled by hand, it should be mixed with a small quantity of damp sand to avoid blowing off or raising dust clouds in windy weather.

The quantity of dust to be introduced depends on the nature of the soil, and the insect's form or stage of growth. When the larvae, caterpillars or other insects present are for the most part in the formative first and second stages of growth, 60-80 kilograms of 12 percent dust per hectare are used; with a predominance of insects in the second and third stages, 100-120 kilograms are used. If the 25 percent hexachlorane dust is introduced, the amount used is reduced proportionately.

For clay soils the amount per hectare is increased 1.5 times; for black soils, 2 times.

It is advisable to introduce the hexachlorane into the soil in the spring, as this gives the best results. When the soil is heavily infested, it is advisable that the application be made in good time, a year before planting or sowing forest stocks.

With such application to the soil, it is also advisable, where areas are limited, to add steam, i.e., to introduce the hexachlorane dust in the spring and then, during the year, treat the soil with steam, repeating the treatments at suitable intervals. Soil sterilization should preferably be carried out once every four or five years.

Further research

At present research is being done on techniques of applying hexachlorane to reduce the amount of dust needed. The scientific research organizations are also working on further advances in chemical and control methods of combatting forest insects, and in particular on the aerial method of fine dispersion sprinkling of forests with DDT, hexachlorane and other chemical emulsions, and methods using toxic chemical systems.

At the same time research is in progress to work out methods for utilizing beneficial insects in combatting harmful forest insects.

(*Article translated from an original Russian text.*)

Commodity Report

Plywood

The steady growth of world plywood production since the second world war reported in our previous reviews has continued. Output in 1955 was estimated to be more than three times that in 1946. The main producing regions, Europe, North America and the Soviet Union, showed increases of more than four, three and two-and-a-half times, respectively. The quantitative increase, from 3,180,000 m³ in 1946 to 10,420,000 m³ in 1955, has been largely due to the spectacular growth of the plywood industry in North America and primarily in the United States. North American output was 1,990,000 m³ in 1946 and 6,110,000 m³ in 1955, an increase of over 4 million m³. The corresponding rise for the rest of the world was about 3.1 million m³. Table 1 illustrates the development of plywood production in the world's principal producing regions from 1938 to 1946 and 1955.

Table 1. – Regional Distribution of World Plywood Production

Region	1938		1946		1955	
	1000 m³	percent	1000 m³	percent	1000 m³	percent
Europe	1 090	36	480	15	2 040	19
U.S.S.R.	885	29	400	12	1 070	10
North America	820	27	1 990	63	6 110	59
Japan	207	7	67	2	700	7
Others	38	1	243	8	500	5
Total	3 040	100	3 180	100	10 420	100

Many factors contributed to the remarkable increase in North American output of plywood; one of the most important is that the war years (1939-45) allowed the industry to expand its capacity and advance its technology, so that, at the end of the war, further progress could be made from this already high level. In contrast, many European plywood mills were destroyed during the war, and postwar progress had to start from low levels. Thus, North American mills, which in 1938 contributed only 27 percent of world production, increased their share to 63 percent in 1946. This share declined to 59 percent in 1955, due to the upsurge of production in other regions. The shares of Europe and the Soviet Union, on the other hand, fell from 36 percent and 29 percent respectively of world output in 1938 to 19 percent and 10 percent in 1955.

In the years immediately following the war, most of the plywood industries outside North America were concerned with repairing, reconstructing and reopening their plants, and operations were often resumed at the prewar technological level. The modernization of existing factories and the construction of new ones encountered economic difficulties, including necessary diversion of available capital to higher priority reconstruction projects. In North America, however, the plywood industries were intact and productive, and consumer demand was rising. New developments in water-resistant and waterproof gluing increased the versatility of the product, especially in marine uses and building exteriors. Plywood became widely used for residential construction and for rural buildings exposed to weather conditions which would have destroyed the older, non-waterproof glues. Molding and shaping processes using heat and pressure have increased plywood utilization in furniture manufacturing and a variety of other industries. New surfaces, such as grain designs, decals, resin-impregnated overlays, and facings of paper, plastics and metals, have increased the attractiveness and usability, and plywood has gained popularity with interior decorators. Among the plywood uses that have expanded greatly are: exterior plywood for building and marine uses, removable and re-usable form material for concrete, interior walls and subfloors for dwellings, and the " do-it-yourself " home crafts.

The increasing scarcity of high quality peeler logs has forced the North American plywood industry to turn to smaller and lower quality wood, not only for cores and for the reverse side of the panel, but also for the face, where improved machinery has extended the practice of removing knots and replacing them with sound wood. Narrower veneers were utilized and lower quality plywood was " made-do " where higher quality had formerly been used. At the same time, plywood manufacturers have turned to new species of timber to extend the variety of raw material supply. Manufacturing processes have been speeded up and costs held down by new machinery for peeling, slicing, patching, and gluing. Greater economy in utilization of raw materials has been achieved by integrating plywood manufacture with sawmills, paper mills, and factories for chipboards and fibreboards. A great increase has consequently taken place in the use of very thin veneers to cover cores of chipboard, cellulose materials, and wood

blocks, which are in many instances manufactured in integrated special plants. Similar developments in technology are also reported from other producing regions.

The increase in plywood production, in North America as well as in other regions, is quantitatively significant, as can be seen from Table 2. The production figures do not show, however, the changes which have taken place in plywood quality, in types of plywood, products such as veneer-coated blockboards, and in the uses being made of these materials. These changes are indeed very important for present and future markets.

Production

The growth in world capacity and production of plywood in the past three years has been concentrated primarily in Europe, North America and Japan (Table 2).

TABLE 2. – WORLD PRODUCTION OF PLYWOOD

Region	1946	1951	1952	1953	1954	1955
	..... Thousand cubic meters					
Europe	*480*	*1 470*	*1 360*	*1 505*	*1 885*	*2 040*
of which:						
Finland	150	314	233	270	346	363
France	44	144	144	147	191	226
Germany, West	60	480	419	484	630	649
Italy	25	140	140	140	150	150
Portugal	5*	25	30	32	31	40*
Spain	10*	30	30	35	40	40*
Sweden	42	57	50	45	56	60*
United Kingdom	38	39	29	34	51	54
Yugoslavia	10	22	22	24	36	41
U.S.S.R.	*400**	*850**	*883*	*946*	*1 024*	*1 070**
North America	*1 990*	*4 090*	*4 240*	*4 930*	*5 020*	*6 110*
of which:						
Canada	192	344	351	460	524	611
United States	1 800	3 750	3 890	4 470	4 500*	5 500*
Latin America	*145*	*150*	*140*	*160*	*180*	*185*
of which:						
Argentina	20*	48	33	29	31	35*
Brazil	110	67	63	79	93	100*
Africa	*15*	*80*	*50*	*80*	*80*	*80*
Asia	*90*	*310*	*415*	*515*	*655*	*830*
of which:						
India	13	26	34	23	29	35
Israel	..	..	8	11	16	20
Japan	67	228	298	409	535	700
Philippines	..	23	34	30	40	45
Pacific Area	*58*	*83*	*64*	*81*	*95*	*105*
of which:						
Australia	48	68	50	67	81	90
New Zealand	10	15	14	14	14	15
WORLD TOTAL	*3 180*	*7 030*	*7 150*	*8 220*	*8 940*	10 420

Note: Regional and world totals include some country estimates. No estimate is available for China.
* Estimated figures.

It emerges rather clearly from the figures available that capacity and production have shown a steady and continuous increase only in those countries where domestic demand is sufficient to justify a rise in the country's manufacturing capacity and where export possibilities play only a minor or insignificant role. A comparison of production with foreign trade figures (Table 3) demonstrates this point.

The plywood producing countries of the world can be classified into four main groups. The first group consists of those countries where foreign trade plays practically no role in the country's supplies or production. Typical of this group are the United States, the Soviet Union,[1] Italy, Western Germany and Canada.[1] The second group is composed of countries which export the bulk or all of their production. This group includes Finland and the countries of Africa and Latin America where plywood industries have been established primarily to meet the needs of European or other overseas countries. The third group of countries comprises those which import all or a substantial part of their requirements. Included here are both the countries which import more than they produce and those which have no production. The United Kingdom, Belgium, Denmark, Greece, and the Netherlands belong to this third group. Finally, in the fourth group are the countries which are fairly self-sufficient in plywood production but export or import special categories.

Japan can be considered to be in a special class, somewhere between the first and second group. Japan's production and domestic consumption have increased substantially during recent years. At the same time exports have also increased so that Japan has become the world's second largest plywood exporter.

The differences in the rates of increase in plywood production in the various regions and countries of the world can, against the above background, be rather easily understood. Countries belonging to the first group have so far enjoyed continuous economic expansion, demand for plywood has risen appreciably and there has been a steady increase in domestic manufacturing capacity. The second group, on the other hand, has apparently not markedly increased its production capacity during the past three or four years, the volume of production having fluctuated primarily because of changing export demand. In the countries belonging to the third and fourth groups there has been, on the whole, a modest increase in production, although new industries have emerged in some countries where no plywood was produced earlier. This last development has consequences for the plywood industries in the major plywood exporting countries, since the large majority of importing countries import plywood in relatively small quantities. Thus the construction of even a modest plywood factory immediately leads to a sharp reduction in import needs. Past experience shows that many plywood factories established in Latin America, Africa and parts of Asia, even though of low capacity, have been capable of producing more than required by domestic markets. Consequently, these

[1] Though substantial suppliers to Western Europe, the U.S.S.R. and Canada still export only a small proportion of their plywood production.

industries have started looking for export possibilities, mostly in the neighboring countries in the same region, and this development forcibly leads to diminishing imports from more remote sources.

A review of the present plywood production situation in the world would be incomplete without mention of the considerable expansion of veneer industries (often distinct from plywood factories) in the tropical hardwood regions and in the main plywood importing countries, notably in the United Kingdom. Although comprehensive production statistics on veneers are unavailable, the reported increases in output, together with the increases in hard fibreboard and chipboard production, represent more competition for plywoods, particularly for use in furniture industries.

Trade

The postwar recovery and further development of world trade in plywood (Table 3) appears very modest indeed when compared with the remarkable increase in world production. The volume of plywood exports had gradually risen from 380,000 m³ in 1946 to 640,000 m³ in 1951 and had regained the level reached immediately before the second world war. The heavy fall in the demand for all forest products in 1952 affected also the international trade in plywood, which fell sharply to 470,000 m³. The slump still affected trade in 1953, when the volume of plywood exports was only 500,000 m³. It was only in 1954 that demand revived and the international plywood market again stood on a firmer basis.

A considerable change has taken place in the regional distribution of world exports during the period 1946-1955. In 1946 and 1947, Finland and North America held roughly equal shares, accounting between them for the bulk of all plywood exported. During the period from 1948 to 1953, Finland alone had about half the world's total plywood exports, with North and Latin-American exports gradually declining and those of Japan and the Soviet Union increasing. This was the situation in 1954 when the import demand suddenly increased, particularly from the United Kingdom and the United States, and led for the first time to a volume of trade exceeding that of prewar, namely 790,000 m³. Finland increased its plywood exports by 83,000 m³ from 1953 and Japan by as much as 107,000 m³. In 1955, the demand further strengthened, and world exports of plywood are estimated to have reached some 930,000 m³. The increase in exports by Japan, from 165,000 m³ in 1954 to an estimated 230,000 m³ in 1955, while production rose by 165,000 m³ from 1954 to 1955, was particularly interesting. Toward the end of 1955, however, the unusually heavy volume of exports in both 1954 and 1955 began to weigh on the market and the opening of the export/import campaign for 1956 was marked by great caution on the part of the importers. In the first months of 1956, it became apparent that the international demand for plywood would be considerably lower than in the preceding years. These developments had their immediate bearing in the main exporting countries, notably in Finland, which normally exports 85 percent of its total production. The Finnish plywood industry planned to cut its production by 20 to 30 percent from the 1955 level and some factories even closed down temporarily. At the time of writing this review, the export market for 1956 was still rather weak and future projects uncertain.

On the importing side, the regional distribution of world plywood trade changed much less in the period from 1946 to 1955. Europe, and particularly the United Kingdom, were the most important buyers, although in 1954 and 1955 the United States appeared as a significant client, notably for Japanese plywood. By and large, it can be said that the development of import demand for plywood in the world has been governed year after year by the purchasing policy of the United Kingdom. Regions outside Europe and North America, which in the prewar period represented some 20 to 25 percent of the total import demand in the world,

TABLE 3. – WORLD TRADE IN PLYWOOD

Region	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955
					Exports					
					..... *Thousand cubic meters*					
Europe	*200*	*230*	*235*	*280*	*265*	*400*	*280*	*300*	*440*	**480*
Finland	136	173	184	207	195	278	220	215	298	320
France	19	18	14	15	12	24	11	21	31	42
Germany, W.	[1] —	—	*2	*3	3	23	6	12	34	31
Sweden	21	18	18	25	24	22	12	15	17	14
U.S.S.R.	**5*	**15*	*15*	*[1]21*	*[1]56*	*[1]79*	*62*	*49*	*65*	**80*
North America	*121*	*191*	*74*	*42*	*35*	*46*	*54*	*42*	*55*	**80*
Canada	64	80	62	23	32	42	43	34	49	72
United States	57	111	12	19	3	4	11	8	6	*8
Latin America	*50*	*60*	*20*	*35*	*25*	*30*	*15*	*15*	*15*	**15*
Brazil	38	45	13	20	11	11	2	—	1	
Chile	6	6	1	7	3	5	1	1	1	
Africa	*4*	*5*	*10*	*10*	*15*	*25*	*25*	*30*	*30*	**30*
Nigeria	—	—	*8	*9	9	*12	*12	*12	*12	
Asia	*1*	*1*	*3*	*10*	*17*	*55*	*30*	*65*	*180*	**240*
Japan	—	—	2	9	16	52	22	58	165	*230
Pacific Area	*3*	*6*	—	—	—	*1*	—	*1*	*7*	**5*
TOTAL	*380*	*510*	*350*	*400*	*410*	*640*	*470*	*500*	*790*	**930*
					Imports					
					..... *Thousand cubic meters*					
Belgium - Luxembourg	19	20	36	28	30	32	24	31	21	19
Denmark	19	13	4	10	15	16	11	19	17	14
Germany, Western	—	*25	*5	*14	16	20	22	21	15	12
Greece	2	4	5	12	2	6	5	9	8	*11
Netherlands	10	32	31	22	30	40	18	32	36	41
United Kingdom	247	261	175	210	183	304	255	147	331	428
United States	14	22	25	12	37	44	50	130	256	*390
Egypt	4	12	8	14	19	22	7	17	22	18

[1] Importers' figures, exports to countries of western Europe only.
* Estimated figure

Table 4. – Comparative Prices of Plywood
Index Numbers (January 1950 = 100)

Period	Finnish birch plywood average f.o.b. value	United Kingdom imports of plywood average c.i.f. value		Swedish 2½" × 7" u/s redwood battens f.o.b.
		Birch	Others	
1950 January	100	100	100	100
April	97	101	100	110
July	95	95	92	117
October	96	94	89	127
1951 January	101	94	87	165
April	104	96	95	187
July	120	111	104	191
October	123	117	113	193
1952 January	127	130	130	202
April	119	123	129	187
July	116	124	126	142
October	108	124	123	161
1953 January	102	120	123	169
April	95	117	113	169
July	102	112	104	168
October	106	111	105	169
1954 January	116	95	103	176
April	116	113	101	173
July	120	117	103	176
October	123	119	104	181
1955 January	127	131	108	186
April	129	133	107	189
July	130	132	107	189
October	129	132	107	185

today represent only about 10 percent. The actual volume of imports by these regions has fallen from some 140,000 to 150,000 m³ in the prewar period to 70,000 to 80,000 m³ today. This development confirms the comment earlier in this article concerning the effect on international trade of the wartime or postwar creation of plywood industries in these regions.

The volume of world trade in plywood has, after the 1945/46 drop to about half the 1938 level, gradually regained and then exceeded this level by one fourth. At the same time, however, world production and consumption, as already mentioned, increased by about three-and-a-half times. The international trade, therefore, represents a progressively diminishing share of total world production. Whether the present volume of plywood exports and imports is to be maintained in the years to come will depend largely on the competitive power of present export plywood industries in the face of the continuous growth of manufacturing capacity in hitherto less developed regions and countries. It is obvious that, to be fully competitive in regions where domestic production of plywood tends to suppress the import needs, the exporting countries will have to pay increasing attention to the quality and variety of their products, to sponsor new uses, and, finally, to follow attentively developments — economic and technical — in other regions. The plywood market today is very different from that of prewar, when a stable use pattern and a steady volume of trade could be taken for granted.

Prices

A study of plywood price movements for recent years reveals many interesting features. During the period from 1950 to 1955, export prices of plywood increased only 5 to 20 percent, depending on the quality and category, while international prices of most other forest products roughly doubled. The average c.i.f. price of plywood imported by the United Kingdom, compared with the Swedish export prices (f.o.b.) for sawn softwood, illustrates well the great difference in the price movements of these two important forest products.

Although average f.o.b. or c.i.f. values do not show actual changes in price quotations because of time lags between closing of contracts and shipment of goods, the figures in Table 4 do provide an indication of longer term price developments. The most striking feature is the relatively great rise of prices of birch plywood, i.e., plywood exported chiefly by Finland and the U.S.S.R. It is to be expected that with the continuous introduction of new categories, varieties and species of other plywoods on the international market, at prices relatively lower than those of birch plywood, the position of the latter will suffer in the long run. The share of other plywoods in international trade has in fact been steadily growing in the past years.

Conclusion

During the postwar period and particularly in the past few years the plywood industry has entered into a new phase greatly different from the earlier pattern. Technological progress in plywood manufacture has opened many new fields of utilization. Present technological achievements do not represent the utmost perfection in plywood manufacture. On the contrary, there is every reason to look forward with optimism to continued progress. Countries without forest industries will direct increasing attention to better utilization of their forest resources, and plywood and veneer manufacturing will certainly have an important part in development programs. On the other hand, already existing industries in the economically more developed regions and countries are sure to take advantage of continuous progress in wood technology, some of which will stem from research in the field of plywood manufacture.

Parallel with the progress in further development of the plywood industry and manufacturing methods, progress in other fields of general economy and industry will no doubt continue to find new uses for better and more varieties of plywood. Thus the manufacture of plywood as such, although not one of the most recent techniques in wood processing, is by no means an industry of the past which has lived its time. The future may therefore still have many surprises reserved for the utilization of, and demand for, plywood and its corollary products.

E. K.

The Work of FAO

Technical Panel on Wood Chemistry

A seventh series of meetings of the FAO Technical Panel on Wood Chemistry took place in Israel from 8 to 11 April. Timed to follow the International Symposium on Macromolecular Chemistry (under the auspices of the International Union of Pure and Applied Chemistry and the Weizmann Institute of Science, Rehovot), the session was opened at the Hebrew University in Jerusalem by the Minister of Agriculture, Mr. K. Luz. The opening meeting, during which Professor H. Mark, Chairman of the Panel, presented a paper on *Nuclear Radiation and its Application to the Chemistry of Wood*, was attended by over 300 people.

Closed business meetings to discuss FAO's future work in the field of wood chemistry were held at the Institute for Fibers and Forest Products Research (Director, Dr. Menachem Lewin) in Jerusalem, as the result of which it was decided to create two permanent working parties within the Panel: one on wood hydrolysis and the other on pulp and paper. Particular consideration was given to a summary statement on wood saccharification specially prepared for FAO by Drs. Hall, Saeman and Harris of the United States Forest Products Laboratory at Madison and for submission for review by the working party established on wood hydrolysis. (See *Unasylva*, Vol. 10, No. 1.)

The Technion in Haifa was chosen for the open meetings which followed, at which five guest lectures by noted specialists were presented, dealing with the fundamental and practical aspects of wood fibre morphology and on the bonding of these fibres to each other and to other solid building materials. These were:

K. Freudenberg: The problem of carbohydrate-lignin bonding in wood

H. W. Giertz: Chemistry, morphology and mechanical properties of the compound middle lamella

E. C. Jahn: Expanding wood utilization through the use of resins

H. Mark: Molecular aspects of adhesion

E. Ott and C. A. Heiberger: New developments in synthetic resins for wood adhesives[1].

A study tour, following the conclusion of the meeting and organized by Dr. Lewin, included visits to the Cargal boxboard factory at Bnei Braq, American Israeli Paper Mills Ltd. at Hadera, a large plywood factory at Affikim and the modern wallboard plant at Sefen, as well as to forest operations under the control of the Forest Research Centre (Director, Dr. A.Y. Goor) at Ilanoth, and of the Jewish National Fund.

[1] Also included with this paper was a "Review of Recent Literature on Synthetic Adhesives for Wood". All the papers will be published in one volume, which it is hoped will be available towards the end of this year.

Teak Subcommission

Thirty-six representatives from 11 countries[1] participated in the first meetings of the Teak Subcommission of the FAO Asia-Pacific Forestry Commission. Held at Bangkok from 9 to 18 February, the session was opened by Field-Marshal Phin Chunhavan, Deputy Prime Minister and Minister of Agriculture, who explained the purpose of the new body. Teak had been known on world markets for many centuries. During the last decades, considerable interest had developed in growing this valuable species in many parts of the world quite outside its natural habitat. The Subcommission was intended to stimulate consideration at an international level of the many problems of silviculture and utilisation, as well as trade.

Mr. C. R. Ranganathan, Inspector-General of Forests, India, had already been elected *ex officio* Chairman of the Subcommission by the full Commission at its last meeting in Tokyo. Mr. Y. S. Ahmad, Inspector-General of Forests, Pakistan, was elected Rapporteur for the session, for which the FAO Regional Forestry Officer, Mr. C. S. Purkayastha, acted as Secretary.

As background to the initial discussions, national reports had been received from Burma, India, Indonesia, Laos and Thailand, where teak is indigenous. Japan submitted a report on utilization aspects of teak, and from France there were two interesting papers on teak grown under exotic conditions at Togo and Dahomey in Africa.

A general exchange of views took place on the ecology of teak, seed problems, natural and artificial regeneration, thinning, protection, management of teak forests, and utilization. As a result, a considerable body of knowledge emerged that can be put to practical use. Particular points were to be further investigated by continuing working parties who would report to the next session in 1957.

Proposed standard grading rules for teak squares, conversions and logs were given a critical examination, and it was decided to circulate the agreed drafts widely in importing and exporting countries, inviting comments from various interests. It was stressed that there was no advantage in having elaborate grading rules unless there was a competent administrative machinery in a country to ensure their correct interpretation and application. Countries were urged to include in their technical assistance programs provision for the training of graders.

Altogether, this new FAO regional body made a good start, which should lead to a concerted attack on the salient problems connected with maintaining teak as one of the world's most sought-after timbers.

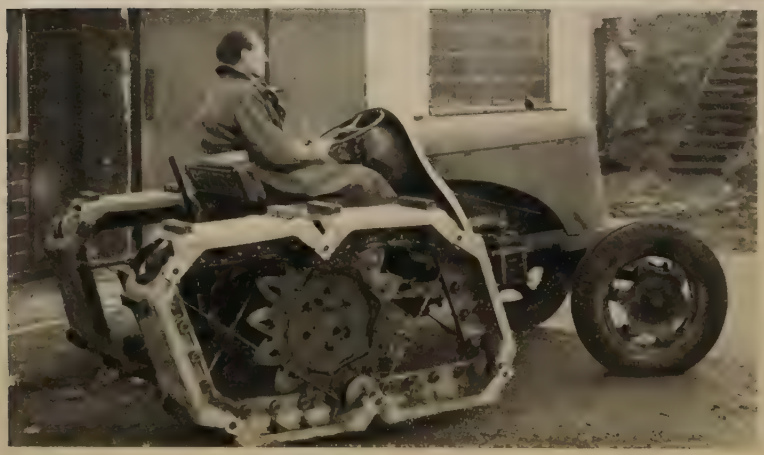
[1] Burma, Cambodia, France, India, Indonesia, Japan, Laos, Pakistan, Thailand, United States of America and Viet-Nam.

Equipment News

Interest in the development of forest utilization and woodworking industries is reflected in the continual demand for information on new equipment. The Forestry Division, FAO, collects such information and passes it, on request, to Member Governments: a selection is published here. FAO accepts no responsibility for the claims of manufacturers.

MERTON OVERHEAD LOADER. The Merton DB 30 Overhead Loader can be used not only for loading, but also for digging, dozing, hauling and lifting. *Specifications*: Engine: David Brown 4 cylinder, 34 hp at 1800 rpm; maximum drawbar pull (bucket empty) 9,700 lb. (4,400 kg.) Speeds: 6 forward from 1.06 to 5.72 mph (1.7-9.2 km/h.); 2 reverse. Winch: power for the winch drive taken from front of engine crankshaft. Bucket: 23 cu. ft. (0.65 m³). Shipping weight: 6 tons.

The Merton Engineering Co. Ltd., North Feltham Trading Estate, Faggs Road, Feltham, Middlesex, England.



NEW ROTAPED. — The Rotaped is a track-laying wheel mounted on tractor, using standard hub fitting. Consists of six links grouped round driving wheel, which lay themselves on ground as tractor moves, and remain always at correct distance from driving wheel. Track chain assembly must always be in contact with wheel.

There is always one complete link on ground giving tractor good support on soft ground.

Specifications: Weight: (Rotaped 20) 110 kg. (243 lb); (Rotaped 40) 125 kg. (276 lb) per track approx. incl. driving wheels.

Leeford (London) Ltd., Engineers, 33 Upper Brook Street, Park Lane, London, W. 1., England.

ROOTSPRED TREE PLANTERS. — The Standard: for hills, stony and heavy soils. Also light soils and sands on level sites. Will plant through roots, brush, stumps, etc.

The Lake States: as above but has 14 in. (36 cm.) middlebuster inserted between coulter and trencher.

Trench can be made up to 11 in. (28 cm.) deep and 3 in. (7.6 cm.) wide. A timer for spacing is included with each planter. Daily planting rates from 6,000 to 10,000. Weight: Standard - 465 lb. (210 kg.). Lake States - 490 lb. (222 kg.).

Rootspred, St. Petersburg, Pennsylvania, U.S.A.

JAYHAWK SUB-SOILER. — The Jayhawk Sub-soiler is equipped with a spinner that fractures the ground to increase its water-holding capacity, controls erosion and helps drain low spots. The point of the Jayhawk S and S Soil Saver digs a dip trench. The spinner creates a cavity, fills it with its own pulverized earth and cracks the subsoil in all directions. Through its action the hard pan and subsoil become a wick to hold moisture.

Ground penetration of point from 25 to 31 in. (64 to 79 cm.) depending upon model. The spinner, 2/3 larger in cross sectional width than point, produces the shattering effect. Spinner does 132 r. p. m. at 3 mph (4.8 km./h.) tractor speed.

The Wyatt Manufacturing Co., Inc., Salina, Kansas, U.S.A.

HENDRICK PANEL SAW MODEL MA. — Designed to operate both manually and automatically.

Carriage starts on the rails at end away from operator and climb cuts towards him. Cut carried downward producing clean finish in full view. In manual operation, cuts are easily performed at rates up to 75 ft. (23 m.) per min. Carriage can be returned to starting position in 5 sec. Automatic drive produces carriage travel speed from 8 to 50 ft. (2.4 to 15.2 m.) per min. For automatic operation machine is equipped with General Electric controls. Change from manual to automatic control achieved by throwing clutch to engage: worm gear driven by ¼ hp motor with belt-driven variable speed drive.

Max. saw diameter - 10 in. (25.4 cm.). Special models available with 14 in. (35.6 cm.) blade.

Hendrick Manufacturing Corporation, 11, Selman Street, Marblehead, Mass., U.S.A.

M.A.N. ROPE WINCHES No. L.W. 2.5. — Winch is flanged to rear of tractor gearbox and driven by power take-off shaft which passes through entire winch gearing so that it may be used to drive implements or machines with the winch mounted. Operated by hand lever from the driver's seat. In 6 models from 2,500 to 6,000 kg. max. pull. All winches equipped with no-return lock making it possible to shift rope drum gears even with the rope pulling a load.

Winch type LW 2.5. Max. pull 2,500 kg. at wire rope length of 50 m. and diameter of 11 mm. Rope sheave pivoted to turn through 360° permits pulls in all directions.

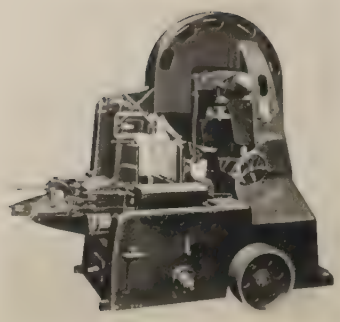
Weight (incl. rope and sprag anchor) - 285 kg.

M.A.N. (13a) Nürnberg 2, Schliessfach, Germany.

GRADALL EARTH-MOVING AND CONSTRUCTION MACHINE. Hydraulically operated machine.

Specifications: 6-cylinder engine, 140 hp, 5 speeds forward, 1-reverse; for the upper structure 70-75 hp, 4 cylinders. Telescoping boom extends to 25 ft. (7.6 m.), or retracts to 12 ft. (3.7 m.), raises to dumping height of 14 ft. 9 in. (4.5 m.), lowers to digging depth of 10 ft. (3 m.) — attachments operate through vertical arc of 116°; boom tilts 45° either way from center — dumping can be done through 360°.

The Warner and Swasey Company, 5701 Carnegie Avenue, Cleveland 3, Ohio, U.S.A.



ROBINSON 54 IN. VERTICAL BAND RE-SAW — TYPE EH/T. — This Band Re-Saw has 4-roller feed and is especially designed for high speed gauge or center sawing, also bevel sawing and boxboard production. Six rates feed through gearbox, viz. between 30 ft. (9 m.) and 180 ft. (55 m.) per min. or, to special order, between 40 ft. (12 m.) and 240 ft. (73 m.) per min.

Pedal-operated simultaneous opening movement to both pairs of feed rollers if set for center-sawing or to pressure rollers only, if gauge sawing.

Specifications: Max. width of saw: 7 in. (17.8 cm.). Max. depth available under top saw guide: 16 in. (40.6 cm.). Max. width between saw and gauge rollers: 6 in. (15.2 cm.), between saw and left-hand feed rollers: 12 in. (30.5 cm.). Main driving motor, 50 bhp. Top saw wheel motor for power rise and fall, ⅓ bhp.

Thomas Robinson and Son, Ltd., Rochdale, England.

WHITING MODEL 2-TM TRACKMOBILE. — It takes the Trackmobile 30 seconds from track to road and from road to track. Operation on road wheel similar to that of conventional truck; max. speed: 16 m.p.h. (26 km./h.) For placing the machine over the track the operator uses hydraulic power to retract road wheels, lowering track wheels onto rails. When road wheels are fully retracted the Trackmobile has standard railway car clearance. Special gearing permits use of 4 speeds for travel in either direction.

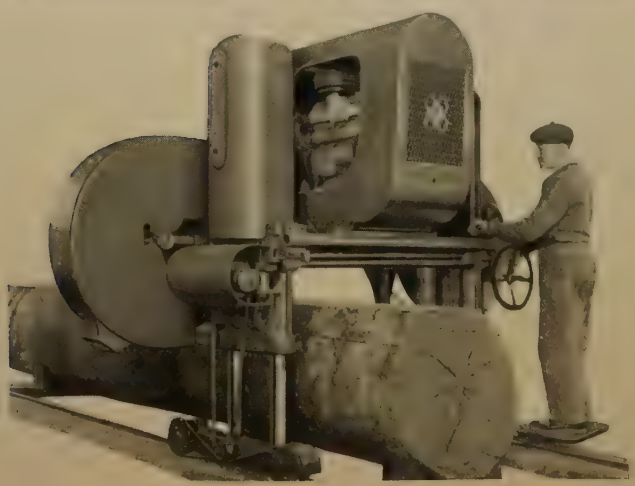
Specifications: Engine 55 bhp. Tractive effort: lst gear: 1.5 mph (2.4 km./h.), 8,400 lb. (3,810 kg.); 2nd gear: 2.5 mph (4 km./h.), 5,300 lb. (2.405 kg.); 3rd gear: 4.0 mph (6.4 km./h.), 3,650 lb. (1,655 kg.); 4th gear: 9.0 mph (14.5 km./h.); 1,300 lb. (590 kg.).

Whiting Corporation, Harvey, Illinois, U.S.A.

SKIL TWO-WAY BLADE. — Blade cuts two ways, in either direction of rotation, after blade face is reversed on saw. Blade should be used in one direction of rotation until cutting edges of teeth become dull, then reversed on saw. As blade cuts in new rotation, cutting edges used in original rotation are automatically honed to new sharpness.

Available in sizes of 5 7/8, 7 1/4 and 8 1/4 in. (14.9, 18.4 and 21 cm.).

Skil Corporation, 5033 Elston Avenue, Chicago 30, Illinois, U.S.A.



HORIZONTAL BANDSAW LOG MILL. — Main advantages: can be completely dismounted, in light sections, heaviest weighs: 440 lb. (200 kg.): quick installation, no foundation or concreting necessary. No sawmill carriage; length of sawing unlimited; need only be provided with rolling track. Inversion of driven pulleys allows speed variations according to hardness and texture of timber. Operator regulates thickness of cut from his seat.

Specifications: Saws logs up to 4.2 ft. (1.30 m.) with precision, 3 to 35 mm. thick. Output capacity 36 to 72 cu. ft. per hour (1 to 2 cu. m.) according to type of timber. Driven by gasoline, diesel or electric motor.

Etablissements C.D., 20 rue Anatole France, Puteaux, Seine, France.

News of the World

The items appearing here are condensed from newsworthy material collected by FAO staff or submitted by correspondents. FAO assumes no responsibility for statements and statistics in items accepted in good faith from contributors.

Australia

• The Forestry and Timber Bureau indicates that a forestry investigation of the more readily accessible parts of the vast Northern Territory of Australia has been under way since 1950 and has now been reported on. The cost of importing timber into the Territory is very high and, because of the interest in development of industry there, the production of timber in that region becomes increasingly important.

In the neighborhood of Darwin, the average rainfall is about 60 inches (152 cm.), but inland it falls off very rapidly and conditions are unfavorable to tree growth. In the area examined there are four broad classes of forest:

1. an open type of eucalyptus forest is the dominant type, but the area which can produce commercial timber is highly restricted;
2. patches of cypress pine on light soils within the eucalypt forest;
3. dense pure forests of paperbark (*E. fitzgeraldi*) on swamplands and along streams;
4. small patches of rain forest on particular sites along streams and on the fresher swamplands.

Exploitation of the forests for mill logs began about 1870 and was greatly speeded up during the second world war resulting in working over a large area of the better forests. Even so, the cuttings would not have had a serious effect if they had not been followed by annual burnings, an established and accepted practice by both white and aboriginal inhabitants. The fires have resulted in serious depletion and deterioration of the forests, and regeneration is not adequate. In only a few places has any attempt been made to prevent the annual burning. In general, then, the picture is depressing.

There are, however, some areas with real future possibilities, given protection from fire and sound management, and the report under reference proposes studying the silviculture of the species having likely commercial value, testing the suitability of exotic species for planting, selecting and proclaiming areas to be dedicated to forest production and introducing sound forest management on the proclaimed areas. If such a program is vigorously pursued, it is expected that the forests of the Territory can be made to produce at least the local forest products requirements.

Austria

• The Austrian Federal Ministry of Agricultural and Forestry Economy has released the first results of its Forest Inventory.

The Forest Inventory distinguished two categories of forest administration, the first of which comprised managed forests, the other being unmanaged forests. The latter consists mostly of small-sized wooded areas. The ratio of managed to unmanaged forests is one-third to two-thirds.

The Forest Inventory had as its prime object the surveying of the unmanaged forests since the study of this important portion of the forest domain hitherto relied on estimations only.

1. The total wooded area of Austria was found to contain roughly 3.3 million hectares.
2. The area of economic (commercially usable) forests is 2.7 million hectares. The rest, particularly in the higher mountainous regions, can be utilized commercially only to a restricted degree, such as protective forests, forests in or with grazing land, or reserved forests where felling is prohibited outright (*Bannwald*).
3. Clear-cut and insufficiently wooded forest areas which urgently need reforestation or re-stocking total 165,000 hectares. Hence, in addition to the areas normally to be reforested, about 20,000 hectares per annum, a further 20,000 hectares more per annum will, in the course of the next eight years, have to be reforested.
4. Concerning the proportion of age classes, small forests clearly show the preponderance of class III (40 to 60 years), whereas the next classes, IV, V, and VI (60 to 120 years) are more or less on the decline.

   This seems to indicate that the higher age classes have been exploited to a strong degree; on the other hand, it opens up hopeful vistas for the future.

   If classes V and VI (80 to 120 years) are considered jointly — this appears justifiable since the average age of maturity can be assumed to be 100 years — the actual ratio of age classes is in no way alarming. It must, however, be emphasized that this is true only as far as the area ratio is concerned.

   Examinations of forest areas over 50 hectares in size have, so far, shown approximately normal proportions of age classes.
5. The average standing timber on the whole of Austria's forests had formerly been computed to be roughly 150 m^3 per hectare, a figure which no doubt is too low.
6. The initial result of the Inventory shows the volume of permissible yearly fellings to be approximately 8.5 million m^3. This is relatively near the annual increment figure revealed by the 1935 Forest Statistics.

Canada

• The report of a Royal Commission on Forestry, which was appointed to examine generally the forest resources of Newfoundland and their fullest development and utilization, recommends that forest policy in the Province should aim at the maximum possible expansion of the pulp and paper industry, and that all other industrial developments based on use of forest resources should be assessed with that objective in view. The Commission, which included Mr. Roy Cameron, formerly on the FAO staff, recommended that a new body should be set up to be

known as the Newfoundland Forest Protection Administration, and to be administered by a board of directors to be appointed by the Lieutenant-Governor, and consisting of a chairman, who shall be the Minister of the Department of Government for the time being in charge of forestry affairs; a vice-chairman, who shall be a representative of one of the two existing pulp and paper companies in the Province; one member who shall be a representative of the other of the two pulp and paper companies; one member who shall be a representative of the saw milling and other smaller timber interests; and one member who shall be the Director-General of the N.F.P.A. to be appointed, on the advice of the board of directors, by the Lieutenant-Governor. The report, which extends to some 240 pages, also recommends a Newfoundland Forest Act to give legislative basis for a provincial forest policy to be officially approved as government policy, but suggests that the passage of such an Act should be deferred until the new forest inventory is completed and the time ripe for the establishment of a Newfoundland Forest Service, which, in the Commission's opinion, should not be later than 1960. In the interim, it is stressed, the necessary legislative action should be taken to implement the other recommendations contained in the report.

• An article in the Convention Issue, 1956, of the *Pulp and Paper Magazine of Canada* deals with *Fertilizers in Forestry and Their Use in Hardwood Plantation Establishment.* The economics of forest management, the article says, have been progressively changing over the years so that presently we are able to conduct more intensive cultural practices than ever before. With today's high level of wood consumption, interest is rapidly shifting from the view of maintaining wood yields to that of increasing production per acre of forest products. This change in viewpoint may well be heralding a new era of forest management.

One forestry practice which requires further investigation as a means of increasing wood yield is the use of fertilizers. Until recently, research in this field has been limited. When the use of fertilizer in forestry is first discussed, many think only of spreading fertilizers on responsive sites. However, fertilizers may have very specific uses in forest management.

1. *Nursery management.* Fertilizer usage in nursery management is a relatively common practice and is generally considered an important part of the management plan. This is reasonable since continuous nursery cropping of high yields of both stem and root is a degrading practice.
2. *Establishing plantations.* Seedlings out-planted initially experience severe competition which is detrimental to growth. Hardwood seedlings are particularly susceptible to competition and plantations often eke out an unsatisfactory, unprofitable existence. The effect of competition is often primarily nutritional and appears to be largely offset by an application of fertilizer. Such an application may significantly increase wood volume and decrease rotation age of newly-established plantations.
3. *Disease reduction.* Forest pathological literature frequently cites cases where healthy trees are less susceptible to diseases than unhealthy ones. Proper fertilization of unhealthy trees may reduce their disease susceptibility.
4. *Increasing seed yields.* Proper fertilization of trees has been shown to increase significantly seed production and produce significant quantities of seed even in poor seed years. This treatment may be of value in areas of poor natural regeneration by treating selected seed trees so that a seed crop would be present at the time of cutting. In any case, such a treatment should be of value to forest geneticists and nursery managers for increasing seed yields on select parent trees.
5. *Forest fertilization.* Few sites have soils which are optimum in fertility, and many sites are deficient in certain nutrients. The most deficient sites are generally those with coarse texture soils, and more particularly those coarse textured soils which are severely burnt-over. Very significant increase in tree growth has resulted from fertilizing such soils with potassium, magnesium, and nitrogen. Other elements, including some of the minor elements, will be found to give marked increases in wood volume on different sites.

Significant increases in wood volume as a result of fertilization have led research workers to study economical methods of applying fertilizers to forests. Aerial application has been recently investigated in the United States by both Syracuse University and the University of Washington. These experiments were not designed to yield detailed costs, but results indicated that the methods were highly satisfactory from a distribution standpoint and probably the only feasible way of getting fertilizer on many types of forest lands.

Ceylon

• The FAO Regional Forestry Officer (C. S. Purkayastha) recently visited the huge organization (Galoya Development Board) that has been built up for the Galoya Development Project, involving dam constructions as well as the development of new colonies. One dam is completed and new ones are projected. According to the scheme, each household is given 3 acres (1.2 ha.) of highland for homestead and growing cash crop and 2 acres (0.8 ha.) of paddy land. Talking with the Chairman of the Development Board, the Regional Forestry Officer discussed the question of establishing communal forests to meet everyday needs of the new colonies such as fuelwood, fence posts and wood for agricultural uses. The present task of forest officers was primarily soil conservation in the catchment areas and extraction of utilizable timber from the areas being cleared with tractors. The question of permanent communal forests would certainly be pursued. The villagers would not be using electricity for the domestic needs, as this was not a practical proposition.

Mr. McVeigh, an FAO expert, was redesigning a sawmill and increasing its production to meet the large demand of timber for the Development Board. Expensive equipment had been produced, including a pressure cylinder for preservation treatment. Some small teak trees had been brought into the sawmill from one of the 30 to 40-year-old plantations which had been cleared in this area. Though the trees had not attained a very big size, the timber appeared to be quite attractive and could in any case meet the furniture demand of the Board.

> " Having seen the timber, I do agree that introduction of this species under exotic conditions is quite a justified effort. "

Elsewhere, the mechanization introduced by Mr. Letourneux, FAO expert, was inspected. The present plan of afforestation of about 2,000 acres (800 ha.) a year against a previous annual program of 300 to 400 acres (120 to 160 ha.) is a distinct achievement. Available land is getting scarce and now plantations are

being created on grazing land after mechanized plowing. The exotic grass *Brachiaria bizantha*, a hardy species with good fodder value, is being introduced in Ceylon, with windbelts at intervals composed of species of *Eucalyptus saligna*, Cypress and *Acacia mollissima*. This seems to be the first instance in the region where forest services are taking an active part in improving pastures, with the windbelts also serving as a source of fuelwood supply.

Chile

• An FAO officer, C. W. Scott, who lectures on utilization at the Forestry School, University of Concepción, writes of a visit to the demonstration center at Llancacura (see *Unasylva*, Vol. 9, No. 2).

> "I hired a four-seater Stinson plane from the Flying Club of La Union to take two fifth-year students, engaged on cruising, and myself over the Llancacura Reserve. We flew over the forest for about half an hour in good weather but at too low a height for satisfactory sketch-mapping. We identified all the main topographical points and got a good grasp of how very steep and broken is much of the terrain in the west of the Reserve, as the cruisers have learnt the hard way, on the ground.
>
> The stand in general looked very uniform. Clearly it would be easy to identify the main species and separate them by observations or photographs when the "ulmo" (*Eucryphia*) is in white flower, or the "tineo" (*Weinmannia*) in red flowers; and the large "coigüe" (*Nothofagus dombeyi*) is probably always separable by its size and crown form, associated with horizontal branches. This type of flight is well worth repeating, to interest and reward keen students and others."

Mr. Scott has also prepared an article on the *Softwood Lumber Trade of the Southern Hemisphere* for publication in Spanish in *Chile Maderero*, the journal of the Chilean Lumbermen's Association (*Corporación Chilena de la Madera*), Santiago, which appears every two months.

A similar article on the export of "pino insigne," *Pinus radiata*, from New Zealand to Australia, and the lessons for Chile, appears in the first issue of *Luma*, a new review being published by the *Associación Chilena de Investigaciones Forestales* (Chilean Association of Forestry Research).

Based on a lecture given at the University of Concepción, the article states that to understand the broad picture of the sawn softwood trade in the Southern Hemisphere it is necessary to remember two vital points:

(*a*) The average quality or grade of lumber cut from trees such as the Paraná pine (*Araucaria angustifolia*) of Brazil and the "kauri" (*Agathis australis*), "rimu" or red pine (*Dacrydium cupressinum*), "matai," "totara" and other species of *Podocarpus* of New Zealand (similar to the *mañíos* of Chile, which are other species of the same genus, *Podocarpus*) is very different from the average lumber that can be cut from the usual "pino insigne" plantations. The difference is especially great when the pine plantations are still young and if they have not been thinned and pruned early enough to reduce their knots and increase their proportion of clear lumber. The Paraná pine, "kauri," "rimu," etc., are usually cut from large trees in natural forests of great age, many decades or centuries old. Naturally such trees yield beautiful clear lumber, free of knots, at least in the outer zones of the lower lengths of the tree bole. It is a very different matter to sell such high grade lumber and to sell "pino insigne" from young trees, especially if the trees have not been pruned and if the lumber has not been well sawn, dried and graded. Yet both New Zealand and South Africa have shown convincingly how much can be made of even relatively young "pino insigne" if it is well handled. The technical literature of both these countries, and that of the southern yellow pine (*Pinus palustris*, *P. taeda*, *P. echinata*, and *P. elliottii*) of the United States, should be studied in Chile and their techniques adopted.

(*b*) Softwood lumber exports and imports may be affected by such factors as return freight facilities for the steamers which carry the lumber, i.e., whether these steamers can find attractive cargoes for their return voyages, and by exchange restrictions, trade agreements and other factors outside the technical qualities and price of the lumber itself.

The great volume of "pino insigne" now planted and growing as fast as it does in Chile presents a great opportunity and responsibility. Few doubt that it has a great future if disaster from disease and fire is avoided by good management and good fortune. The profits, for the plantation owners especially, may depend greatly on what action is taken on the warnings from other countries to which this article invites attention. Proper tending of the plantations and good sawing, drying, grading and, where necessary, preservative treatment are as important in Chile as they have already proved to be in New Zealand and South Africa. Selling prices must be competitive, of course, and in this matter Chile has advantages to exploit and obstacles to overcome.

Argentina, Peru, Uruguay and Bolivia, potentially rich neighbors of Chile, which lack adequate softwoods, appear to be good markets to try to develop. The basic attractions of well-prepared "pino insigne" are that it is light, strong, very easy to dry and work, durable when treated with preservatives and very easy so to treat, stable and relatively free from splitting, warping or abnormal compression wood. Such abnormal wood gives appreciable trouble in Paraná pine and the southern yellow pines of the United States, *vide* many excellent studies by the Forest Products Laboratory, Madison, United States.

The article mentions in conclusion that the Chilean softwoods other than "pino insigne," the native Chile pine (*Araucaria araucana*), "mañíos" (*Podocarpus* and *Saxegothaea*) and "alerce" (*Fitzroya*) are very attractive timbers of high quality. The supplies of *Araucaria araucana* are very limited, unfortunately, and those of the "mañíos" are often effected by the poor shape of the trees, in certain zones, with many stellate or deeply fluted boles. However, much can be made of these native woods, within the available supplies, by good milling and grading. With such handling they could find wider markets and better prices. As in New Zealand, however, so in Chile the main softwood problem and hope for the future lies in "pino insigne" and similar exotics. A variety of such trees should be planted, to reduce the risk of disease inherent in forests of one species, whether planted or natural, native or exotic.

Colombia

• At the last Arbor Day festival celebrated throughout the country, 1.5 million young trees were distri-

buted to the public and to schools. An interesting feature was the coverage of 13 cities by four airplanes supplied by the Government, delivering small trees for planting to one city, receiving other trees and carrying them to the next city as a symbolic and fraternal message of love of trees.

At present, there are four Forestry Commissions operating in the country, each with a $60,000 budget, a forest engineer in charge, four supervisors of forest nurseries, and twenty-five workmen. Each Commission operates in a catchment basin where programs for the development, protection and conservation of natural resources are under way. Two hundred thousand trees are planted per year after a carefully studied selection of species.

Each Commission, within its radius of action, is working to set up regional tree nurseries in collaboration with mayors and school teachers, in this way implementing a tree-planting program. Each Commission also supervises forest extraction operations with a view to getting them on to an efficient basis and is in charge of the public domain lands. It is probable that, in 1956, four additional Commissions will be set up, thus expanding such forestry work to over half of the country.

Cuba

• An increasing interest in forestry is taking place, activated by lectures and press, radio and television campaigns. The *Sociedad Silvicola Nacional*, with the effective collaboration of the *Colegio de Silvicultores* and the Ministry of Agriculture, is developing a forest program under the name of *bosques comunales* (community forests). There are preparations for planting ten million seedlings of several native and exotic species, including *Eucalyptus*, *Casuarina*, *Tectona* and *Khaya*. The planting of *Bursera simaruba* on sandy soils of the coastal region is being investigated.

The *Sociedad Silvicola Nacional* is granting portions of the *bosques comunales* to primary schools for their attention and care. A prize of US $50 has been offered to the group of students who, over a period of two years, show the best results, thus stimulating the pupils' interest towards trees.

Ecuador

• *La Forestación Artificial en el Ecuador Central*, by Dr. M. Acosta-Solis, Director of the *Istituto Ecuatoriano de Ciencias Naturales*, deals with the arid and semi-arid inter-Andean region of Ecuador; the booklet describes the ecology, soils, and natural vegetation as a basis for tree-planting research. It goes on to describe the coniferous and broad-leaved species tried, with special attention to pine, cypress, araucaria, eucalypts, casuarina, acacia, willow, and poplar, and several less generally used species. There is an important section on techniques of planting, with emphasis on spacing. There are included useful tabulations of seed source, germination, and survival of over 100 species, based on Ecuadorean experience. Summaries in Spanish, English, French and German are included.

Egypt

• In its efforts to improve the forage resources in the west desert, particularly in the 25 kilometer strip along the Mediterranean Sea, the Government of Egypt, in co-operation with United States International Co-operation Administration has set aside a 24,000-acre grazing area to be used for demonstrating different methods of grazing management and range improvement. Although the program is not yet fully underway, some rather interesting developments have taken place. A visit was made to this area by delegates to the first Session of the FAO Working Party on the Development of the Grazing and Fodder Resources of the Near East, held in Cairo from 14 to 21 March. The working party is made up of agronomists, animal husbandmen and a few foresters.

Five thousand acres of the Ras el Hekma Experimental Range have been given semi-protection, or rather, considerably lighter grazing during the past three years. Although the area receives only 150 millimeters of precipitation, the vegetation has made remarkable response to this semi-protection treatment. Plants, which under the usual pattern of grazing, are mostly unseen, having been grazed to the ground line, are now 0.25 to 0.5 meter tall and producing large quantities of forage. One observer has estimated that if only 50 percent of this herbage is eaten by grazing animals, the total production will be several times greater than from similar areas where utilization is complete. In addition, the cover of vegetation is increasing over the soil for greater protection against wind erosion.

Another interesting phase of the experimental program is the seeding of productive basins and drainage bottoms, where there is greater accumulation of soil moisture, to desirable grasses and legumes. The first crop from these fields is being cut for hay each year and stored for emergency periods of short forage supply. The fields will then be grazed along with the other part of the range.

The over-all plan for this experimental range is that several kinds of good management practices will be tried and compared. All of these will be practices which can be adopted by the people and their herds who are living in the area. As a matter of fact, local people and their herds will provide the animals used on the area. Detailed research will not be carried out but rather the program will involve demonstrations of how the use of this kind of grazing land can be improved to the benefit of the land and the owners of the livestock. It is the sort of thing that is needed in many countries to create interest among the people in improving their practices of land use.

Germany (Federal Republic)

• An inspection report has been received on afforestation work in Burgenland. This report pays special attention to *Ailanthus altissima* (syn. *glandulosa*).

In the Provincial Forest Nursery at Weiden-am-See, various tree species suited to the continental, dry climate of Burgenland are grown, used especially for the planting of shelterbelts in the northern districts of Burgenland. Besides poplars and various maples, a number of exotic species such as *Ailanthus* are raised.

Ailanthus is sown relatively late (from 20 April to 10 May), as the seed requires warm, dry soil in order to germinate. Wet and very salty soils are not suited to the species. The seedlings are transplanted at the end of October and beginning of November in the first year. They are lifted by machine, because the plant develops a tap-root that is bigger than the aerial part; lifting with a specially constructed machine is very simple and no harm is done to the root, whereas damage is very likely to occur in lifting by hand.

The plants are set out in the shelterbelts in the second half of November. In its first years, *Ailanthus* is susceptible to injury from frost; in particularly cold spots it dies back, but the roots remain sound and readily sprout again. No susceptibility to serious pest infestation has been observed.

A visit was made to shelterbelts established on agricultural land. There are four shelterbelts, about 4 to 5 kilometers long, set at intervals

one behind the other with a spacing of 1 kilometer between. The width of the individual shelterbelt, of mixed *Ailanthus*, robinia and maple, varies between 30-50 meters.

Ailanthus manages to live on the worst soil. Unlike robinia, it helps to form a humus layer in a short time through the shedding of its leaves. The rate of growth is similar to that of robinia, yet at the time of the inspection it appeared to be the most thriving tree of all the plantations.

Germany (Eastern)

• Progress in forest operations, as in all other fields of human technical activity, depends not only on the choice of good equipment but even more on its correct use and maintenance, as well as the application of the proper working techniques. The need for better training of forest labor is becoming generally recognized, and in our mechanical age, many countries devote increasing concern to problems of work efficiency through scientific investigation and workers' training.

Two interesting publications from Eastern Germany, both intended to familiarize the practical forester and woodworker with advanced equipment and techniques, have recently been brought to our attention. *Beiträge zur Technisierung der Forstwirtschaft* (Contributions to the Mechanization of Forest Operations) 1953, pp. 175, and *Die Motorkettensäge, Handbuch für die forstliche Praxis* (The Chain Saw, Handbook of forestry practice) 1954, pp. 148, both well illustrated and written in plain language to be easily understood by the worker. They are two good examples of how technical information and instruction may be passed on to personnel engaged in forest operations.

Guatemala

• Decree No. 543, which appeared in the Official Gazette of the Republic of Guatemala on 9 February 1956, established the system of *Unidades* for the exploitation of the national forests and for the development of forest industries.

The system of *Unidades* is similar to that to be found in Mexico (see *Unasylva*, Vol. VII, No. 2, p. 50) and their establishment has been declared a public service. Private forests which happen to be situated within the forested area set aside for a *Unidad* are only to be incorporated, however, by the request of their owners. The State is to maintain a very strict control not only over the setting up of each *Unidad*, which will be preceded by a thorough investigation of the management problems involved, but also over their actual operation. Both forest officers and forest rangers to be attached to the *Unidades* are to be nominated by the Government, which will pay them from the credit account of the *Unidad*.

The same decree prohibits the export of roundwood or hewn timber. It authorizes the granting of exemption from import dues on material to manufacturers wishing to start up forest exploitation or to set up a *Unidad*.

The decree also adopts the metric system for the measurement of timber.

Hungary

• Higher education in forestry is provided by the Sopron University for Forest Engineers. The courses last four and a half years and, having passed the examinations, the students are awarded a forest engineering diploma. Specialized training was given for some years by this University but, recognizing the disadvantages of this education, in the school year 1954/55 the University returned to general forest engineer training.

Secondary high school training is carried on in two technical forest schools, the courses lasting four years. To enter one of these schools, eight classes of the primary school have to be passed and, after finishing their studies — generally when they are 18 — the graduates obtain a certificate which is of the same value as that given by non-specializing general secondary schools.

The training of skilled workmen is carried on regularly; for instance, for the handling of motor saws technical courses are arranged by the National Directorate of Forests; the participants live in a training institute and also receive payment during the course.

For the more highly educated, secondary school and lower-grade school professional men, forestry refresher courses are provided by the National Directorate of Forests. Thus in a few weeks the participants in these courses may obtain some idea of the results of investigations and of important theoretical and practical problems of forestry dealt with since the time they were qualified. Private owners who only have small woodlands are given professional training at similar courses.

India

• The Government of India has just published the report of the third session of the Central Board of Forestry, which was held in the State of Madras in May 1955.

This meeting was particularly important because it had to examine especially the part reserved for forestry in India's second Five-year Plan (1956/57-1960/61). The Board has approved in the main this Plan, which provides as follows:

	Lakhs of Rupees
Development of forest research and education (direct expenditure by the Center)	300
Development of matchwood plantations (50 percent subsidy)	100
Preservation of wildlife (grants to States and direct expenditure)	110
Preservation of the use of secondary timbers by preservative treatment and seasoning (50 percent loans and 50 percent direct expenditure)	100
Development of forest administration in the States (grants to State Governments)	100
Development of modern techniques of timber extraction and communications (long-term loans)	400
Expansion of planting activities connected with valuable commercial timbers such as teak (long-term loans)	200
Creation of industrial plantations such as wattle, blue gum (long-term loans)	100
Acquisition of valuable private forests (long-term loans)	200
Supply of fencing materials at concessional rates for rotational pastures and plantations (grants)	50
Co-ordinating and technical service organization at the Center	30
TOTAL	1,690

Note: 1 lakh = 100,000; 4.76 rupees = US $1.00.

The Board has also observed that certain projects of importance to the States, such as the development of the forest industries, including industries using forest accessory products, and the restoration of degraded forests, also deserve to be included in the Plan.

Among other important recommendations made by the Board are those which have been formulated in conformity with the recommendations of the Fourth World Forestry Congress, such as:

> The Central Soil Conservation Board be requested to consider the possibility of setting up a Research Station to study the problem of raising shelterbelts in Rameswaran Island and similar areas.
>
> The supply of plantation stock to private owners of forest should be at cost price, but technical advice should be free.
>
> A special study of forest grazing in the country should be carried out by the Center.

State working plans should pay special attention to the management of wildlife.

States should undertake special legislation to prevent the destruction of trees, especially in hill stations and other hilly areas outside forests as well as in urban areas.

Among the other important recommendations of the Central Board is that which aims to give to a Central Forestry Commission the task of examining important management plans drawn up in the States.

Iraq

• The FAO forestry adviser, G. W. Chapman, reports that Tree Festival celebrations were held in all but two of the provinces of Iraq during last March. In some of the forested northern *liwas*, celebrations were not restricted only to a show at the capital town of the *liwa* but also in sub-district centers. In Baghdad, the King, accompanied by all the Ministers of the Cabinet, attended the celebration. Satisfactory publicity was achieved in the local press and radio broadcasting services.

Tree-planting activities connected with the Festival mostly took the form of roadside avenues. The Festival seems to have gone off most satisfactorily and is serving its purpose in stirring public interest in forestry and tree planting in a most effective manner.

Kenya

• The Government has decided to settle nearly 7,000 African families in the territory's forests during the next three years. A large number of those families will be Kikuyu.

There is some doubt in the public mind because many Kikuyu forest squatters employed by the forest department before the emergency were associated with the development of the Mau Mau organization and, not unreasonably, it is believed that not all the Kikuyu who will be allowed to return to the forest can be guaranteed to resist renewed threats or temptations.

The Government is taking a carefully calculated risk. Whereas previously these employees of the forest department were widely scattered and lived on land allocated for the cultivation of maize and other food crops, they will now live in villages under close control. No village will have more than 110 families and each village will be under the supervision of a European forester.

A pilot scheme has already been started. The objectives are first an increase in forest development, particularly the replacement of large area of natural forest by exotic softwoods, and secondly to relieve overcrowding in the Kikuyu tribal reserve while also helping some 30,000 men, women and children to become useful and self-respecting members of society. Employment as forest department squatters has always been popular with the Kikuyu, who appreciate the opportunity of cultivating virgin land. The villages will have welfare and social service amenities.

Philippines

• An FAO officer working at the new Forest Products Laboratory at Laguna writes of progress being made there.

Research work in timber testing is being continued according to the pattern established in previous months, and will continue in the same fashion for several months to come. The personnel has been given instructions and technical assistance in each phase of the work from establishing plans for correct procedure to making the final report which records the results and conclusions of the research. Projects include:

1. *Evaluation of large leaf mahogany.* The tests and report on this species in the green condition have been completed. The specimens that are to be tested at 12 percent moisture content are being conditioned in a chamber built for that purpose. The evaluation of strength at this moisture content and the report of the values can be readily incorporated later in the report on green strength.
2. *Evaluation of species for tool handles.* Material has been secured for standard strength studies.
3. *Evaluation of strength of structural timbers.* Several thousand tests of green material have been made since 1 October 1955 on specimens representing many species from the Laguna area. The results of computations are being tabulated and are available for inspection and review.
4. *Gravity survey.* A report on the specific gravity ranges of 32 species from 10 major regions has been written and reviewed. This report summarized available information on the variation in gravity values for these species. The report indicates, contrary to general opinion, that in the majority of cases, the average density of a species in one region is not significantly different from that in another region when compared at the 5 percent moisture content level. This fact should be of great help in future sampling for extreme and representative qualities of species.

Thailand

• In connection with the first session of the Teak Subcommission of the Asia and Pacific Forestry Commission (APFC), on 11 February the delegates were taken out to visit the teak sawmills of the Forest Industry Organization and the East Asiatic Company at Bangkok. This provided the occasion for a river trip to see how the logs were rafted down the river from the forests to the mills.

On 12 February, the delegates left Bangkok by a chartered plane for Chiengmai but, due to bad weather conditions, the plane could not land and they had to return to Bangkok. The itinerary had to be changed and the delegates left by train on the following evening for Lampang and Chiengmai.

During the train journey the delegates had the opportunity of seeing some of the natural teak forests and some of the deciduous Dipterocarp forests worked under the coppice with standard system to supply fuelwood to the railways. On reaching Lampang on the morning of 14 February, the delegates were taken by car to visit the natural teak forests at Mae Moh and Mae Huat and teak plantations at Mae Tark.

Passing through Mae Huat, the method of working these forests was explained. These forests are worked under the selection system and the delegates saw how teak trees over the prescribed girth limit were girdled in advance of felling. The delegates had also the opportunity of seeing elephants at work dragging logs from the forest.

At Mae Tark the plantations were created under the agri-silvicultural system (*taungya*). The growth of the experimental plantations in Imperata area was not very satisfactory as the seedlings had to face serious competition with Imperata grass in their early life. After completion of the inspection of the various activities in the Lampang area, the delegates

left by jeep for Chiengmai, the second biggest city of Thailand.

On 15 February, the delegates saw the experimental planting at Doi Sudep as well as the Huay Keo arboretum. In the latter area which is quite close to Chiengmai, the public is invited every Arbor Day to plant trees of economic value as well as ornamental plants. Besides, guests of the Royal Forest Department are also invited to plant some memorial trees. The delegates were all invited to plant each a memorial tree.

From the arboretum, which is situated at the foot of the hill, the delegates were taken to the Doi Sudep Experimental Station when they passed through some of the dry deciduous Dipterocarp forests before reaching the hill evergreen area. The experimental station is at an elevation of about 1,000 meters. At this station, important tree species of the north as well as the exotic temperate trees, fruit trees and ornamental plants are being experimented with. The work actually started in the year 1948 with a very limited fund and up to now about 40 species of temperate plants have been tried here, including the California Red Wood (*Sequoia semipervirens*) sapling, which was given as a souvenir to H.E. Field Marshal Pibul Songgram when he made a goodwill visit to the United States of America. In this experimental station a good success has been achieved with the plantation of *Pinus merkusii* — a two-needle pine generally found at lower elevation and *P. khasya*, a three-needle pine of higher elevation.

On 16 February, the delegates went out to see the teak plantations at Chieng Dow and also some protection works of watershed areas. During the trip the delegates also had the opportunity of comparing the teak forests of Chiengmai with similar forests seen on the previous day which were definitely of better quality. The poorer growth of teak at Chiengmai is attributed to poorer soil.

The delegates had further opportunity of seeing the experimental plots where exotic eucalypts are being tried with a view to finding some quick-growing species to replace the poor type of dry Dipterocarp forests. Preliminary indications are that *Eucalyptus citriodora* is likely to be suitable for afforestation in the poor dry sites whereas *Eucalyptus deglupta* is better suited for moister location. The introduction of the fast growing eucalypts has become necessary to meet the urgent problems of fuelwood supply to the tobacco curing stations located in outlying areas in the northern part of Thailand.

The trip took the delegates through various forest types, including Dipterocarp and hill evergreen forests. The latter at present is not worked to any great extent but serves the important protective function in the catchment areas of the rivers which are the only sources of water supply to the people living in the lower reaches.

Finally the delegates were led to Mae Na Oy teak plantation which was started in 1954 also under the *taungya* system. The growth so far appears to be quite favorable despite the fact that very few teak trees are found growing naturally in the surrounding forest.

Turkey

• A member of the FAO forestry mission forwards an official report on the Forest Research Institute of Turkey, which states that, at present, the Institute has two experimental forests. One is Büyükdüz Forest, which has the characteristic qualities of the coastal forests of the Black Sea, the richest forest district of Turkey, and the other is the experimental forest of Çamkoru, which serves as a bridge between the poorly forested steppe land and the forests of the Black Sea district.

The above forests are selected as experimental areas for conducting research work and are organized to serve as model forests of the Forest Service.

Büyükdüz is a mixed high forest consisting of fir, beech, pine and oak, located at a distance of 25 kilometers north of Karabük. Its altitude varies between 850 and 1,500 meters. The forest covers an area of 2,290 hectares; the growing stock per hectare is about 310 cubic meters.

A management plan of the forest is being drawn up and in connection with it, a general plan for 51 kilometers of roads, which should be built for protection and logging purposes, has been prepared and marked on the land. The project for a road of 6 kilometers has been completed and the work for actual road building started elsewhere. During 1955, stand improvement cuttings were done in compartments of this forest.

Çamkoru Forest, which is 24 kilometers northwest of Kizilcahamam, contains stands of *Pinus nigra* and *Pinus silvestris*. The altitude varies between 1,300-1,650 meters. The forest covers an area of 650 hectares and has a growing stock of about 100 cubic meters per hectare.

The general road plan of this forest has been completed and the construction of a main road started. The management plan of Çamkoru forest was drawn up according to a modern method in 1955. During 1954 and 1955, stand improvement cuttings were applied in two compartments of the forest.

On an experimental area in Bala, shelterbelts have been established in order to increase the agricultural production by avoiding the drying effect of hot summer winds on crops and soil.

The shelterbelt area lies east of Bala, at a distance of 22 kilometers and within the State Breeding Farm. The direction of shelterbelts is vertical to that of the predominant wind in this area. The total length of the shelterbelts is 5.6 kilometers and the width 30 meters; they cover an area of 220 hectares. The tree species suitable to the existing ecological conditions are used for the establishment of the shelterbelts.

An experimental pasture has been created near Bolu where forest pastures cover a large area, in order to carry out research on grazing problems and to ease the burden of grazing off the forests, by improving the forest pastures. This pasture is situated in the locality of Aladağ, on Seben Mountains, 27 kilometers north of Bolu. The experimental pasture, which covers an area of 43 hectares, is divided into 7 sections. It has an altitude of 1,350 meters. Three of these sections are assigned to different rotation grazing systems, another three sections to experiments on grazing intensity, and the remaining one section to pasture improvement.

Sweden

• The Society for Practical Forest Improvement at Uppsala is principally a consulting organization with the purpose of helping its members, on a scientific basis, with problems concerning reforestation. Co-operation with forestry institutes and agencies working in the same field, is pursued as far as possible.

In the period of 1956-60, the Society's work will mainly be:

1. *Seed Supply:* After completing the inventory regarding pine (*Pinus silvestris*) in parts of Sweden of immediate interest, the work with this species is to be carried out by propagating plus trees and establishing seed orchards. In total, 25 of these have been planned with an area of about 120 hectares (300 acres). In 20 years these are to yield seed for a plant production of about 120 million plants per annum. Pine grafts already planted in the orchards fill an area of about

30 hectares. Gradually, as the number of clones of each orchard become complete, the orchards will be definitely established. The intention is to get the four smallest orchards (1 to 2 hectares) ready in 1956 and all the orchards ready before the end of 1960. With a view to their isolation, extensive protection plantings and the elimination of surrounding pines have been made.

The selection of plus trees of spruce (*Picea abies*) is being continued and seed orchards started. In the first orchard now planned for the middle of Sweden, spruces selected with an intention of gaining the highest possible pulp production are to be included. Increased attention is being devoted to birch, and plus trees of birch are propagated for seed production.

The studies concerning different methods for the treatment of graft trees in orchards in order to obtain an abundant and early seed harvest will be intensified.

2. *Nurseries and Plant Care:* Studies on nursery questions are to continue and practical information concerning the establishment and management of nurseries given by instruction and pamphlets. Investigations started in 1955, concerning the importance of temperature and moisture for germination and plant development (sowing season, irrigation, etc.) in the experimental nursery at Frigesund will be finished in 1956 and the results published.

   A compilation of the comprehensive material of the Society with regard to the analyses of nursery soils will be done.

   Data on the storing and care of plants are compiled and instructions regarding plants are distributed.

3. *Reforestation:* Developments in questions concerning methods and tools for forest regeneration are followed with a special consideration of biology. Detailed studies regarding the cause of plants dying back during the first year are being continued in co-operation with the silviculture staff of certain members.

   Plantations with some North American and North Asiatic tree species have been laid out according to earlier plans.

4. *Instruction and Extension:* In its capacity as a service organization, the Society is to seek to bring out the more important results concerning reforestation, culled from literature and research institutes, and is also to inform members about practical experience. By 73 reports and personal contacts during demonstrations out-of-doors, it is possible for the Society to keep its members up-to-date with developments.

The comprehensive picture-archives of the Society are to be completed and the collection of instruction pictures (in color) in the matter of reforestation, especially concerning nursery management, plant care and planting methods, is at the disposition of members.

United Kingdom

• A note in *Scottish Forestry*, Vol. 10, No. 1, concerns the aftermath of the storm damage suffered in early 1953. With probably the greatest number of trees lying on the ground at one time that has ever occurred in Scotland, conditions existed for unprecedented insect damage, but luckily the subsequent wet summer ensured that the trees remained greener than was expected. The pine shoot beetle infestation was not as bad as was thought possible. The beetles have, however, increased quite considerably and have killed off many of the isolated trees which remained standing in the devastated areas, and also spread into adjoining woodlands. With the removal of the timber, their breeding ground has been reduced and their numbers should gradually come down to normal proportions before 1958 and so enable replanting with conifers to be undertaken.

The jungle of brushwood provided, and still provides, ideal cover for rabbits, but with the advent of myxomatosis the expected rise in the rabbit population did not take place; in fact, very few rabbits are now seen in woodland areas. The clearing of this lop and top is, however, important to enable any remaining rabbits to be killed. Serious fires, luckily, did not ravage any of the areas. Small areas were burned and some sawmills, but nothing to what could have happened.

Now that nearly all the blown timber has been removed, the second stage in clearing up is in full swing. Odd, scattered trees are being felled and preparations are going forward for the eventual restocking of the 25,000 acres (10,000 ha.) of woodland involved in this disaster. Opportunities have arisen for the possible restocking of these areas by natural regeneration now that rabbits have been considerably reduced, but a great deal of activity is foreshadowed for nurserymen in making good the damage.

The loss of both capital and income has been heavy on individuals but a National Fund made payments towards the cost of repairing and renovating roads, bridges, fences and buildings, and also in respect of blown timber. Payments at the rate of £40 per acre (£100 per ha.) for the first ten acres and £30 an acre (£75 per ha.) thereafter were made, up to a maximum of £5,000 to any one owner.

Although the volume affected amounted to less than 5 percent of the standing volume of timber in the United Kingdom, its loss is greater when considered in relation to the reserve of growing timber of its age and size.

• Proposals to create what were described as parish forests have been outlined by representatives of the Forestry Commission to members of the Royal Commission on Common Land.

This scheme, it was stated, was intended to satisfy objections by commoners and other local people, and from a wider public, to the acquisition for forestry purposes of land regarded as local property.

The plan was that where an owner of the soil and a majority of commoners signified agreement in principle to the use of a suitable common for afforestation, it would be open to the Minister of Agriculture, after consultation with local authorities and other interested bodies, to designate the ground as a parish forest. Compensation would be payable to those who exercised rights of common, and the freehold would be acquired by voluntary negotiation with money from the Forestry Fund.

The portions most suitable for forestry would then be vested in the local authority. Thereafter, the Forestry Commission would plant and maintain the forest on behalf of the local community, financing the work from the Forestry Fund. If necessary, an advisory committee of local people would be set up to ensure that local interests were taken into account so far as practicable.

Particular attention would be given to amenity, and the provision of access for the public to the maximum practicable extent, and of picnicking and camping sites where appropriate.

When net expenditure and interest on capital had been recovered, responsibility for the forest would be passed to the local authority for

administration in accordance with plans approved by the Forestry Commission. The arrangement would be analogous to the management of a private woodland by its owner in accordance with a dedication agreement.

United States of America

• *Forest Science* has now entered its second year as a quarterly journal of research and technical developments. As the first new nation-wide American forestry journal since 1905, *Forest Science* is international in content and in appeal, being devoted to articles and reviews of primary interest to scientists, educators, and specialists. The need for the new enterprise has been demonstrated by its first year's history. Over 900 pre-appearance subscriptions were received and more than 1,200 had subscribed by the end of 1955. Volume One contained 42 articles on 356 pages dealing with such topics concerned with the forest as species crossability in spruce, an economic approach to multiple-use, deer and cattle range relations, and the taxonomy and evolution of the sawflies.

• Genetical work in the Pacific northwest has led to the formulation of tentative guides for the selection of plus trees and superior stands in Douglas fir. The indications for plus trees are:

1. A plus tree should be one of the fastest growing trees in a given stand.
2. The crown should be thrifty but not overly dense or limby in comparison with its neighbors. It should have high vigor in the upper third of the crown and low vigor from there downward.
3. The plus tree's crown should be narrow. It should retain a wedge-shaped, well-pointed top, but from the upper third downward the outer edge of the crown should remain somewhat parallel to the stem.
4. The bole should be straight, have a high form factor, and be reasonably clear of branches between nodes and on the lower bole as trees approach maturity.
5. Limbs in the upper third of the crown should not make a sharper, upward angle with the stem than 60°/more nearly horizontal or drooping branches are better.

The indications for superior stands are:

1. It is better than surrounding stands or better than expected in a general locality or elevation.
2. Better growth than expected is a first requirement.
3. The stand should contain an above-average number of high quality trees approaching the plus trees in desirable characteristics

Once selected, superior natural stands should be improved by removal of slow-growing, badly-formed and diseased trees which are bad pollen parents. Thinning and the mulching effect of the slash can be expected to stimulate crown growth. In thinning a superior stand, high quality trees should not be removed simply because they do not produce cones, since they may provide pollen. Additional measures such as pruning, topping, watering, fertilizing and insect and disease control should be undertaken in superior stands.

• American utility companies believe that they will be able to save themselves a great deal of money and trouble by adopting glass fiber poles for electric power cables and telephone lines.

One of the greatest enemies of the wooden pole is the woodpecker, which causes great damage. Wooden poles are also damaged by termites and by fungi.

Tests have shown that glass poles withstand temperatures ranging from well below zero to more than 100° F. in the sun. They weigh much less than wooden poles, and are therefore easy to instal and, from the esthetic point of view, they have the advantage that they can be made in any color.

• The Weyerhaeuser Timber Company, in an eight-page advertisement in the February issue of *Reader's Digest*, tells the full story of modern industrial forestry and what the forest industry is doing to grow and wisely use forest resources. The section, illustrated with striking, full-color pictures, is entitled "Promise of the Trees — The Story of Modern Forestry and Tree Farming in the Pacific Northwest." It presents a complete report to the American people on a subject of universal public importance — the conservation and management of privately-owned forestlands. Part of a continuing public information program, the message explains the company's policies and objectives and the progress made in the modern philosophy and science of forest management.

• A report entitled *Wood Residue in North Carolina — Raw Material for Industry* has been issued by the United States Forest Service cooperating with the North Carolina Department of Conservation and Development. The conclusions are summarized as follows:

1. Large permanent sawmills can profit by establishing a market for their wood residue with pulp mills in their area. Since the preference is for clean chips in dependable volume, they should determine the quantity of solid wood residue produced at their plant both in log and slab form; investigate the feasibility of installing log and slab barking equipment and chipping and screening equipment; and investigate the problem of transporting the chips by trailer or rail to the pulp mill. They might also look into the possibility of purchasing slabs from small sawmills within a reasonable radius of their plant.
2. The concentration yards in North Carolina could benefit by making a survey of the small sawmills supplying them with lumber to determine the daily quantity of slabs that they could obtain from these sawmills and the price that they would have to pay for the slabs. They should further investigate the slab debarkers under development or on the market, chipping equipment available, and screening equipment available, with a view to collecting wood residue at their yard for conversion to pulp chips. The concentration yard owners, fortified with the figures on the amount of pulp chips they could produce per day, should also approach the pulp mills or synthetic board plants to develop a market for this material.
3. The veneer and plywood plants could investigate the feasibility of selling their cores for pulpwood if they are not already doing so, and might look to the synthetic board plants as a possible outlet for their scrap veneer.
4. It might be profitable for the furniture plants in the State to determine the amount of solid wood waste produced at their plants, as contrasted with fine wood waste, and thus be in a position to quote prices on this material to synthetic board plants or to concentration yards that might produce pulp

chips for pulp mills capable of using hardwoods as well as pine. The furniture plants could also determine the volume of material that is of sufficient size to interest a manufacturer of smaller items. Perhaps listings of such material could be handled through a furniture association or through some advertising medium, so that this material would get back into commerce instead of to the boiler room.

5. Local communities that have several wood-using industries might arrange for detailed surveys of different types of wood residue available and present these data to the North Carolina Department of Conservation and Development to assist in helping new industries find suitable locations where ample wood residue of the right quality is available.

Persons interested in organizing companies for utilizing wood residue should obtain full information on the processes of interest. In addition to obtaining the technical information on a process, it will be necessary to make market surveys to determine the need for the proposed product.

Yemen

• The FAO Regional Forestry Officer for the Near East, participating in an official exploratory FAO Mission, writes that one of the most striking features of the landscape is the great number of trees which appear everywhere, except on the bare mountains above 2,500 meters in elevation, on the high plateau (from Naqil-Sumara to some 75 kilometers north of Sanaa) and in the coastal strip of Tihama.

A cross-section of the country from the sea to the high plateau shows first a strip of some 15 kilometers alongside the coast which is mostly sandy and bears no trees except a few doum (*Hyphaene thebaica*) and palm trees growing wild, and the bush *Suaeda fruticosa*.

In the lagoon of Lobeyia, *Avicennia officinalis* covers some 40 hectares, and is said to extend up to the Saudi Arabian border to the north, on perhaps 2,000 hectares. Near Hodeida, the same Avicennia is met, with another mangrove tree *Brughiera gymnorhiza*.

There are a few shifting sand dunes, but the economic potentially of that area is so small that it would not be worth undertaking their fixation at the moment.

A second parallel strip, varying in width from 10 to 30 kilometers has a better soil, is less open to the powerful sea wind, and bears large tracts of *Salvadora persica* and *Cadaba rotundifolia*. Tamarisk — mostly *Tamarix articulata* — appears in the wadi beds, and often reaches tree size, sometimes up to 10 m. high. The acacias also appear, first in the wadi beds, and then eastward on the flat land which is occasionally flooded.

In many places, *Acacia flava* (Sallam) appears almost as a weed invading cultivated or formerly cultivated fields, and seems afterwards very difficult to eradicate.

The next area is the foot of the mountains, where the valleys open widely in the Tehama. The cultivated fields are very important, and trees of fairly good size exist either scattered or sometimes grouped in a true, close forest, as for example some 2,000 hectares in the Wadi Surdad valley; this stand is composed mostly of *Dobera roxburghii*, called locally Daber, with some *Delonyx elata*, *Salvadora persica*, and the poisonous tree *Adenum obesum* with beautiful flowers. *Balanites aegyptiacum* and species of *Grewia*, *Leptodinia* and *Pyrotechnica*, are also met sometimes.

Leaving the Tehama to climb towards the first plateau, the slopes of the mountains bear a real forest of *Acacia*, varying in size from a dwarf, twisted bush to a tree 6 or 7 meters high, according to the depth of the soil, the exposure of the slope, the gradient and the elevation. Acacias appear to be the most common tree in Yemen; it is so abundant in many places, such as the hills between Tais and Ibb, between Wadi Rima and Wadi Zebid, north and north-west of Saada up to the Saudi Arabian border, that the stands may truly be called open forest. From a quick aerial survey and from field trips, it is estimated that this open forest covers nearly one million hectares.

It was not possible to identify all the Acacia species but amongst them were *Acacia nubica*, *A. hamulosa*, *A. verugera* and *A. spirocarpa* on the low, hot slopes. The "thala," which is closely related to *Acacia seyal*, reaches an altitude of 2,500 meters. It is often carefully preserved on the cultivated terraces, where it replaces the "ilb," *Zizyphus spina christi*, above 1,500 meters of elevation.

The "ilb" is the second commonest tree. It grows either in thick groves on the wadi banks subject to floods or on the terraces. It is often pollarded to obtain the leaves as fodder for livestock and to use the twigs as fuelwood. Its wood is also used as timber. The "ilb" gives to the landscape around Tais, and Ibb, its peculiar aspect of a giant orchard.

One wonders why the peasants do not grow fruit trees (olive or others) rather than *Zizyphus*, on their cultivated terraces. One wonders also why the natural vegetation is so completely xerophytic, in spite of a total rainfall amounting to 600 millimeters at least. The explanation may be that the lack of rain during the winter and the early spring, combined with the winter cold, which has been called sometimes a physiological drought, results in a temporary excessive drought, which precludes many of the Mediterranean or temperate plants and fruit trees from surviving.

Many thorny or xerophytic shrubs are mixed with the acacias on the slopes; in the valleys, the vegetation is often luxurious and dense and includes many *Grewia*, *Maerua*, *Commiphora*, *Dodonea viscosa*, and a great variety of *Ficus: F. salicifolia*, *F. morifolia*, *F. vasta*, etc.

Cordia myxa, grown as a shade tree on the coffee plantations, deserves special mention because of the excellent quality of its wood, used as building timber and for furniture making. Its planting should be developed and encouraged.

A few carobs (*Ceratonia siliqua*) are grown on the terraces of the Jebel Saber, near Tais, and in the Wadi Rima valley. *Tamarindus indica* grows well, and its fruits and timber are appreciated.

A notable feature of this part of the country is the extensive development of the euphorbs, mostly *Euphorbia amak*, which invades formerly cultivated fields and the degraded forest. The plant is totally useless, and the reclamation of such land for afforestation might be worth consideration.

When one reaches the high plateau, the almost complete disappearance of trees is striking: there are only some tamarisk (perhaps *T. orientalis* and *T. articulata*) a few acacia and zizyphus in the wadi beds, or along the irrigation channels.

In summary, there are a great variety of tree species in Yemen, the more important being the many acacias, giving firewood and charcoal, the multi-purpose *Zizyphus spina christi*, and the timber-producing *Cordia myxa*.

Book Notices

GROWTH HABITS OF THE EUCALYPTS. M. R. Jacobs. Forestry and Timber Bureau, Commonwealth of Australia, 1955. Canberra. pp. 262. £ 1.10.0 (Australian currency, inclusive of postage).

This monograph-like book condenses information available only in several out-of-print publications of the Australian Commonwealth Forestry and Timber Bureau, in papers on the treatment of Eucalypt forests by numerous authors, and in field notes by Bureau research officers, and by students at the Australian Forestry School under the direction of the author.

The morphological characters and physiological reactions of the eucalypts are described as a basis for eucalypt silviculture and management. In this presentation the author effectively shows how the silvicultural characteristics of the genus Eucalyptus fit into the broad pattern of behavior of the world's forests.

The chapter on the leafy shoots describes production and development of leaves, buds, and branches; that on the development and maintenance of mature crowns describes growth stages, size, shape, and longevity of crowns; that on growth stresses deals with longitudinal and lateral stresses of erect and leaning stems and their possible causes, and there is a chapter on gum veins. These four chapters set the stage for the final two chapters on silvicultural characteristics and the effect of growth habits on the treatment of eucalypt forests. In the former are discussed light and root competition, advance growth, seed production and natural seedling establishment, crown classification and "shyness" and "abrasion", spacing, natural thinning, coppicing, bark, fire, wind, rainfall, and parasites. The final chapter gives useful information on silvicultural systems, the group selection system, advance growth salvage; special sections are devoted to the treatment of jarrah, tall eucalypts on good sites, regeneration of eucalypts in savannah woodlands, treatment of the "red gum" group, and treatment of low quality forests.

A useful list of references, and seven pages of detailed index headings are extremely valuable additions.

Although the book is intended primarily for people interested in Australian forestry, it is highly recommended to foresters in countries outside Australia where the planting of eucalypts is beginning to take on increasing significance.

The author's paper, based on this book, for the world Eucalyptus Conference called by FAO in Rome, 1956, appears in this issue.

FOREST TREES OF SARAWAK AND BRUNEI. F. G. Browne, pp. 370, Government Printing Office, Kuching, 1955. $12.00.

This attractively illustrated book should prove useful to tropical foresters in general and those in Southeast Asia in particular. After describing the territory and its forests, which the author divides into five sub-divisions of the Tropical Evergreen Rain Forest, with some 17 types or sub-types, there are given very practical keys to, and in the identification of, trees and timbers. The tree key is based on characteristics of leaves, branching, color of latex, bark, crown form, trunk form, and wood color. The key to the common woods is based on size arrangement, and number of pores, color of wood, weight, structural features such as resin canals and rays, deposits, and exudations. This is followed by detailed but very readable descriptions of more than 160 genera or species arranged according to families. Some of the species are given under the local name only.

The bibliography and the index, as well as the map on the inside back cover, add to the utility of this book, which the author modestly points out is not a flora or a scientific work but rather a preliminary survey of the forest wealth of Sarawak and Brunei.

BIBLIOGRAPHY OF PLANT PROTECTION, 1951. (*Bibliographie de la Protection des Plantes*, 1951. *Bibliographie der Pflanzenschutzliteratur*, 1951). By J. Bärner. pp. 420. Paul Parey, Berlin-Hamburg, 1955.

This volume, listing the titles of the international literature on plant protection published in 1951, is the twenty-third issue in a series covering all literature since 1914. Only the years 1945 to 1950 are still outstanding, but this gap will be closed in the near future.

The 1951 list with more than 12,500 titles is, as all previous ones, based on the card index at the *Biologische Bundesanstalt für Land-und Forstwirtschaft in Berlin-Dahlem*, which now contains over 300,000 titles.

Titles, table of contents, introductions and chapter headings are printed in three languages, German, English and French. In order to guarantee a fast and sure way of locating any desired literature, the contents have been subdivided into the following main chapters and subtitles:

I. *General section.* Collective works and textbooks; reports of activities and congresses; bibliographies; biographies.

II. *Diseases and causes.* General pathology; diseases with various or unknown causes; diseases not caused by parasites; vegetal parasites; animal parasites; viruses.

III. *Diseases and host plants.* Vegetation and cultivated plants in general; survey of the incidence of plant diseases and parasites; cereals; potatoes and beets; legumes and grasses; commercial plants; fruits; grape-vine; forest trees, timbers, parasites of wood and wood preservation; ornamental plants, garden and greenhouse plants; tropical commercial plants; storage protection; diseases of uncultivated plants and cryptogams.

IV. *Measures of plant protection.* Plant hygiene; plant therapeutics; advancement and organization of plant protection; statistics of the incidence of plant diseases and parasites.

An alphabetic author index concludes the voluminous list.

EL EUCALIPTO. (The Eucalypt). J. P. Vidal. pp. 188. Tomo I. Ministerio de Agricultura, Bogotà, Colombia, 1955.

Beginning with general descriptions of the principal identifying characteristics of the genus Eucalyptus, to which it devotes some ten pages, this publication presents brief histories of the introduction of eucalypts into France, Italy, Spain, the United States, Argentina, Brazil, Cuba, Ecuador, Peru and Colombia. The major part of the book is given over to detailed notes on each of over 150 species of eucalypts. The species are then listed according to the principal uses for which they are found suitable. Also included are lists of species arranged alphabetically by scientific and by common names. These lists might have increased usefulness if they had been accompanied by the page numbers bearing the descriptive notes. This publication should prove helpful to Spanish-reading foresters, as will the Spanish edition of *Eucalypts for Planting* by A. Métro, FAO

Forestry Study No. 11, which is expected to be available for distribution during 1956.

FLORE DES VÉGÉTAUX LIGNEUX DE LA MAMORA. LA NATURE AU MAROC. (Flora of Woody Vegetation of the Mamora. Nature in Marocco) A. Métro and Ch. Sauvage. Rabat. 1955. pp. 498.

The extensive cork-oak forests of the Mamora are the subject of this most useful flora. It is intended to serve as a guide to identification of the natural and planted woody vegetation in this zone, which is such a popular picnic and outing area for the people in the vicinity of Rabat and nearby towns of Morocco.

There are brief descriptions of the geographic situation, the soils, the climate, the natural vegetation groups, floristic details, the human factors, the management policies and practices, and the reforestation and regeneration of the eucalypts in the Mamora. A helpful key for species determination precedes the detailed information on the species themselves which are arranged under the headings of Gymnosperms, Monocotyledons, and Dicotyledons. The sketches and plates add greatly to the usefulness of the book. Some of the plates are particularly attractive. The glossary and the index facilitate the use of this flora.

WALDBAU (Silviculture), pp. 418, 1950. ANSPRACHE UND PFLEGE VON DICKUNGEN (Appraisal and Tending of Young Stands), pp. 80, 1952. WALDPFLEGE (Tending of Forests), pp. 200, 1953. By J. N. Köstler. Paul Parey, Berlin-Hamburg.

With these three publications the author, Director of the International Forestry Center (CIS) from 1939 to 1946 and since Professor at the University of Munich, has made a substantial contribution to the modern concepts of silviculture. His endeavor is to awaken in the reader an understanding of forests as living communities. There is no place for any schematic or generalized rules for forest treatment. On the contrary, for each particular stand there is one best solution for treatment, which the forester must be able to determine individually and execute.

The first volume is a textbook on silviculture, in which Köstler makes his lectures available to a wider readership. The second study deals with problems of stand improvement through selective thinning. In recent years, a marked change of view has taken place, particularly in Central European silviculture, where it has been recognized that care of stands through periodic cuttings is at least as important as regeneration in forest management. Professor W. Schaedelin developed a method of continuous care of tree communities throughout their life from seedlings to mature trees based on the ideas first brought forth by Karl Gayer. In his noted study on the improvement of stands through selective tending (third edition, 1942) Schaedelin himself admitted that he had made many assertions without proof. To bring more light and certainty to the problem, Köstler analysed over 100 thinning sample plots, principally with a view to recording the effects of selective tending. His study confirms the positive results of such measures, but also shows the importance of adaptation of method and technique to the special conditions of each particular young stand.

Köstler's other work on *Tending of Forests* is a continuation of his textbook on silviculture. Whereas the textbook dealt with the problems in general, the author here goes into details by discussing practical silvicultural solutions for 333 examples, selected from private forests in southern Germany. They are of interest to foresters elsewhere because of the valuable contribution to ideas on the influence of forest ownership upon progress in forest management. The examples are illustrated by a number of excellent photographs, maps and diagrams.

FAO STAFF CHANGES

A reorganization of the internal structure of the Organization has been carried out this summer along lines laid down by Dr. P. V. Cardon, Director-General, on the authority of the Conference of FAO. The purpose of the reorganization has been to bring about the integration of FAO's Regular Program, which is financed by funds voted by the Conference of FAO, and the Technical Assistance Program, which is sustained by special funds allocated through the General Assembly of the United Nations.

There is now fully co-ordinated planning of both these programs. Closer liaison has been established between Headquarters, the Director-General's Regional Representatives, and the FAO Representatives in individual countries who were formerly styled Chiefs of Technical Assistance Missions. Also with other international organizations.

As part of the changes involved, Mr. Pierre Terver who was formely Chief Technical Assistance Officer, Forestry, has assumed the post of Director, Program and Budgetary Service, in the office of the Director-General. The separate Technical Assistance Unit within the Forestry Division has been abolished, and a Program Co-ordination Service has been instituted in the office of the Director, with Mr. L. J. Vernell as Chief. In addition to other duties, Mr. Vernell has been Editor of *Unasylva* since early 1948 and will continue in this function.

Mr. A. Huber has resigned from the Forestry Division to take up a post as Cantonal Forester in his own country, Switzerland. Mr. Aung Din of the Burma Forest Service has assumed an appointment in the Forest Technology Branch, while Mr. Giménez-Quintana, formerly *Ingeniero* of the Spanish Forest Service in Sevilla, has joined the Forest Policy Branch. Mr. Nasu, formerly of the Forest Experiment Station in Tokyo, has been appointed Forestry Officer in the office of the Regional Forestry Officer for Asia and the Pacific at Bangkok.

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FORESTRY AND FOREST PRODUCTS STUDIES

U.S.$ £

No. 1 - Planning a National Forest Inventory 1.00 5s.

September 1950, viii + 88 pp. (EFS)
New edition in preparation.
Prepared for the use of administrators and advisers.

No. 2 - Forest Policy, Law and Administration 2.00 10s.

December 1950, iv + 211 pp. (EFS)
A comprehensive study designed to assist countries in formulating sound forest legislation and administration.

No. 4 - Grazing and Forest Economy 2.00 10s.

March 1953, v + 161 pp., illustrations. (EFS)
This study is the combined work of the Forest Policy Branch of the Forestry Division, and deals with the problems as they affect temperate, tropical and arid regions.

No. 5 - Elements of Forest Fire Control 1.00 5s.

March 1953, vi + 110 pp., plates. (EFS)
Fire prevention and control should be regarded as an integral part of forest management. This short study outlines the organization and administration involved in a protection program.

No. 6 - Raw Materials for More Paper: Pulping Processes and Procedures Recommended for Testing 2.00 10s.

April 1953, xii + 172 pp., tables. (E)
These findings of an FAO Pulp and Paper Consultation in Rome, Italy, December 1952, form a short handbook covering pulping processes for fibrous raw materials from new sources and procedures recommended for the investigation of new raw material for paper.

No. 7 - Forestry Abstracts Coverage List 1.50 7s.6d.

1953, vii + 180 pp. (Trilingual)
Prepared by the Commonwealth Forestry Bureau from its card index of literature forming the basis of its quarterly publication, *Forestry Abstracts*, this list forms a comprehensive and well-tested collection of publications carrying material of significance to forestry.

No. 8 - National Forest Policies in Europe 3.00 15s.

August 1953, iii + 370 pp., tables. (EF)
Member Governments of the FAO European Forestry Commission presented reports covering administration, improvement in quality and quantity of wood produced, utilization of forest products, timber trade, labor questions, education, research and statistics.
A valuable work of reference.

No. 9 - Research in Forestry and Forest Products 3.00 15s.

September 1953, vi + 323 pp., tables. (E)
This world directory of research institutions gives an outline of their objectives and summaries of their activities.

No. 10 - Directory of Forestry Schools 3.00 15s.

September 1953, vi + 290 pp. (E)

U.S.$ £

No. 11 - Eucalypts for Planting 3.50 17s.6d.

September 1955, v + 403 pp., illustrations, bibliography (EF. Spanish in preparation)
One of the most versatile tree groups for the creation of new forests is the genus Eucalyptus. This monograph by a recognized authority summarizes available material or botanical and silvicultural characteristics, nursery and planting methods, and technological properties and uses.

FORESTRY DEVELOPMENT PAPERS

No. 1 - Du choix de tracteurs pour le débardage 2.00 10s.

March 1954, x + 190 pp., illustrations, tables (EF)

No. 2 - World Festival of Trees 0.75 3s.9d.

July 1954, vi + 74 pp., (EFS)

No. 3 - Forest Plantation Protection against Diseases and Insect Pests 0.50 2s.6d.

June 1954, v + 41 pp., (EFS)

No. 4 - Handling Forest Tree Seed 1.00 5s.

March 1955, ix + 110 pp., (ES)

No. 5 - Tree Seed Notes 3.50 17s.6d.

I. Arid Areas
II. Humid Tropics
March 1955, iii + 354 pp., (ES)

No. 6 - Tree Planting Practices for Arid Areas 1.50 7s.6d.

March 1955, vi + 126 pp., illustrations (ES)

No. 8 - Tree Planting Practices in Tropical Africa 3.00 15s.

March 1956, xii + 302 pp., illustrations (E. French and Spanish editions in preparation)

No. 9 - L'agriculture nomade. Vol. I: Congo belge; Côte d'Ivoire. 2.00 10s.

1956, 230 pp., illustrations (F)

No. 10 - Tree Planting Practices in Temperate Asia: Japan 1.50 7s. 6d.

March 1956, 156 pp. illustrations

Occasional Papers

(*Mimeographed*)

Wood Burning

May 1955, 57 pp., illustrations. (EFS)
Free on application

La Carbonisation du bois par fours transportables et installations fixes

May 1955, 79 pp., illustrations. (F. English and Spanish editions in preparation). Free on application

Directory of Wheel and Track-type Tractors Produced throughout the World 3.00 15s.

1955, iv + 371 pp., (Trilingual)

Forest Seed Directory 1.00 5s.

1955, 158 pp., (Trilingual)

The initial letters between parentheses indicate English, French and Spanish editions.

Timber Bulletin for Europe

QUARTERLY MARKET REVIEW

Bilingual edition: English/French

Timber Bulletin for Europe is a quarterly publication prepared jointly by the Secretariats of the United Nations Economic Commission for Europe and the Food and Agriculture Organization of the United Nations.

It contains cumulative quarterly statistical data for the current and preceding year for various European countries, the United States of America and Canada, on the following products :

pulpwood, softwood logs, hardwood logs, pitprops, sleepers, soft and hard wood, sawn softwood, sawn hardwood, plywood, fuelwood, poles, pilings, posts and veneers, pulp and pulp products.

The data relate to output, stocks, exports and imports.

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Single copy: $1.00; 7s. 6d.; Swiss francs 4.00.

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